DESTRUCTION BY DEMOLITION, INCENDIARIES AND SABOTAGE

FIELD TRAINING MANUAL
FLEET MARINE FORCE
UNITED STATES MARINE CORPS

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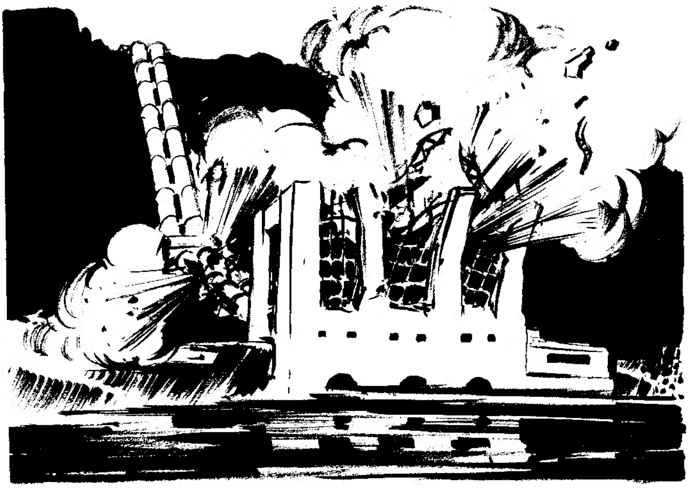
FOREWORD

This publication has been written and prepared for publication by Lieutenant Colonel G. McGuire Pierce, Marine Corps Reserve, with the generous assistance of many large industrial operators and manufacturers in the Los Angeles area and elsewhere.

It has been considered advisable to give the publication a very limited distribution in view of the confidential nature of the contents. It will be valuable as a reference work in connection with special operations of air and ground forces.

—T. Holcomb.



"When the tremendously destructive force of intelligently placed or directed explosives against enemy production activities is realized, then will the importance of training men for this type of mission assume its rightful place in training and in actual effort."

INTRODUCTION

Curtailment or elimination of any war production effort may be obtained through many mediums, one of which is applied physical force. Other and more abstract forms, such as propaganda, are effective, but are generally directed against morale and are not ordinarily within the normal activity of a military organization.

Applied or self-induced energy acting as an agent of destruction, produces a more immediate and definite form of sabotage, and when employed against a combatant enemy in a theater of operations, or on his production front, becomes the particular function of the military.

To correctly understand this work it is first necessary for the student to distinguish between sabotage in its more commonly defined form, and DESTRUCTION BY DEMOLITION AND INCENDIARIES.

> Sabotage is generally known as that form of destruction or damage, applied by undercover agents against the war efforts of an enemy on the home front. The agents may be either enemy civilians or members of the military, but they operate in civilian clothing and pose as loyal citizens, or friendly aliens, while carrying on carefully prepared schemes of damage and destruction in a surreptitious manner. They usually work from within an industry or social order, and entrance and continued presence therein depend upon apparently peaceful, unobtrusive, non-violent conduct.
>
> Destruction by Demolition and Incendiaries as defined and contemplated herein means damage and destruction to the war effort of a combatant enemy, wherever those efforts exist, by uniformed men as a tactical military operation. It differs from sabotage principally in the fact that it employs violence openly and in uniform to achieve its aims.

The immediate objective of both is of course the same, eventual defeat of enemy war effort on that very important front in modern warfare—the vital industrial capacity and the necessary moral stability of the HOME FRONT. Wars of the past have been largely fought by military men in battles, divorced in a large measure from civilian efforts at home. Modern wars and particularly the present one, with the tremendous demand for,

and expenditure of, manufactured products places those productive agencies into a classification that is vital and absolutely necessary to a victorious conclusion.

It seems, therefore, apparent that the nation achieving the greatest production capacity of the agents of war for the longest uninterrupted period of time, and possessing men with the spirit, courage, and training to use them, will prevail in the end over any foe, where these elements so essential to modern warfare are present in smaller quantity.

Secure in this knowledge it therefore now becomes as essential to understand how to damage and destroy this behind-the-lines industrial capacity, and to train and employ military forces in the effective use of this new science of warfare, as it has previously been to train men in the science of weapons.

When the tremendously destructive force of intelligently placed or directed explosives against enemy production activities is realized, then will the importance of training men for this type of mission assume its rightful place in training and in actual effort.

Like the human anatomy every industry and every service has a heart upon which its continual existence depends. Alike also is the fact that each will stop when the heart is stilled. Herein is shown the heart of industry, what and where it is, and how it may be destroyed.

This publication covers much more briefly and generally than the importance of the subject justifies, that phase of military effort obtained through the applied force of fire, impact and explosion against the industrial activity of combatant enemies. The subject is treated as sabotage only in so far as it embraces the common result—delay and destruction of the enemy's war effort on the production front.

When applied offensively against facilities in use by the enemy such destruction is normally referred to and recognized as sabotage. But when these same agencies of destructive force are employed by ourselves to our own equipment, it is ordinarily a defensive measure and designed for the purpose of denying the possible and probable use thereof to an enemy. The lessons to be learned herein are applicable alike to either offensive or defensive destruction, and it should be remembered that in either case, such destruction should be assigned to and entrusted only in men especially trained for that purpose.

Most vital activities are subject to the destructive influence of demolition and sabotage, but this work embraces only those which if damaged or destroyed would seriously curtail, delay or stop some vital war effort of a combatant enemy.

The studies contained herein were conducted under direction of many noted plant safety and protection engineers, assisted by such additional technical personnel as were required to cover and illustrate all types and stages of damage and destruction. The excellent professional training and outstanding cooperation of these men should encourage dependability in this publication, and it is regretted the confidential nature hereof forbids any other acknowledgment.

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GENERAL

1. The material contained herein has been obtained principally through the conduct of a School of Demolition and Sabotage by the Marine Corps in a large typical industrial city and area. Here most strategic types of industry and facilities were available for study and demonstration.

2. Factories and utilities were selected for study based upon three factors:

(a) Essential in some direct manner to war effort.

(b) Employed generally by all nations for the same purpose.

(c) Operated everywhere by machinery, equipment or methods similar to those used and available for study in this country.

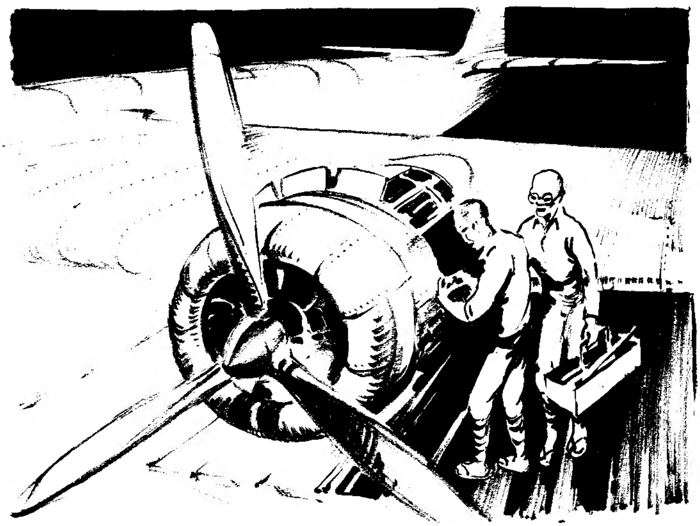


Fig. (a) Essential to the war effort

3. In studying this manual it is to be remembered that the equipment described or pictured herein has been carefully selected for its recognizable physical comparison with other similar use equipment wherever found in the world.

4. Thorough familiarization with the functions, as well as the appearance and other characteristics, of every essential piece of equipment is necessary for the trained demolisher. Without this he cannot fully appreciate his exact mission, nor how it can be accomplished under the conditions of confusion and great physical strain that accompany an actual destruction detail.

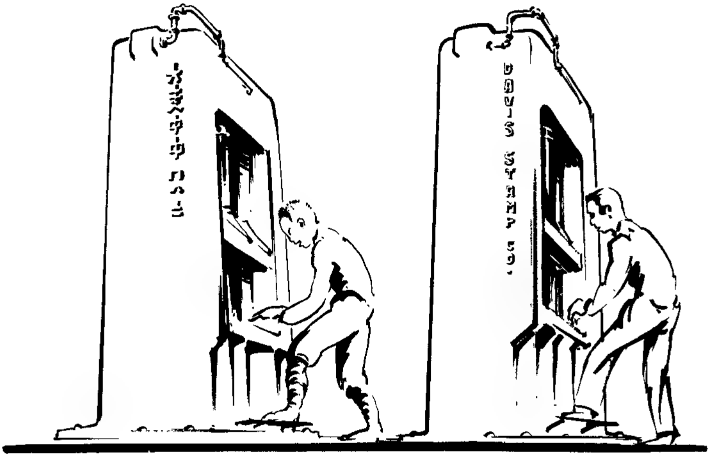


Fig. (b) Similar machinery the world over

5. It is necessary for the student of destruction to first have a thorough basic training in the nature and usage of demolition and incendiary equipment. His knowledge of the use of these agents of violence must be sufficiently complete to permit his mind to be free for the extremely difficult task of reaching the area and identifying his exact target, calculating, placing, and initiating the charge, and returning, that he may live to repeat his destructive ability.

6. Students of destruction should be selected very carefully, and only those who possess a high degree of resourcefulness, agility, endurance, and courage should be assigned for training and actual missions. They should be thoroughly schooled in scouting and patrolling, and the majority of this training should be conducted between darkness and dawn.

7. (a) A poorly planned or executed demolition undertaking may defeat the element of surprise, which is as essential in this as in any other type of military operation. Rarely is there a second opportunity to execute a mission successfully, where the first has failed, without the risk of losses out of proportion to the value to be obtained.

(b) The importance of a mission of this character justifies the

use of current aerial reconnaissance and photographs along the route of approach to and including the objective. From this and other available information a scale relief, or three dimensional, map should be constructed placing *every* important terrain and constructed feature thereon. The existing ground cover should be added in scale and the whole should be accurately colored. Culverts, bridges, roads, fences, telephones, power lines, etc., all become important after night and especially so to a detail engaged in operations requiring stealth, speed and accuracy sometimes deep within enemy territory. Maps of this type can be constructed in any suitable scale by a trained section within a few hours time. (See Field Training Manual on Relief Map Making FMFTC. 1943).

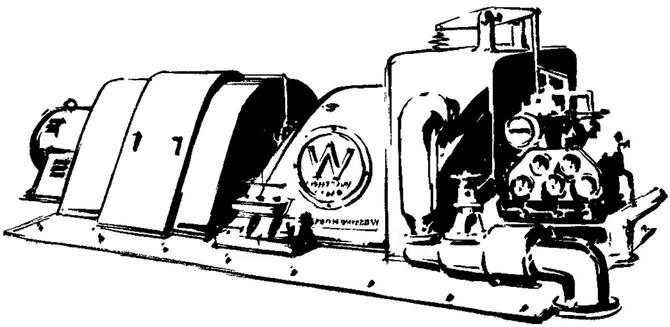
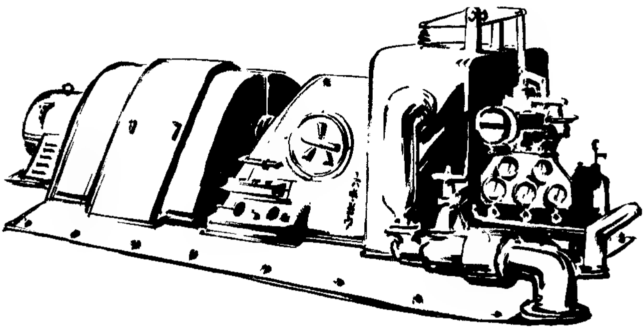


Fig. (c) Whether in Tokio or Toledo the appearance and functioning will be similar



(c) The maps when completed should always be studied with scale or neutral backgrounds and under the same light conditions expected to be encountered during the execution of the mission. With it routes of approach and escape, rendezvous areas and targets can be identified under many conditions similar to those which will be present during the actual effort. These points should then be indicated with symbols of tape on the map and the whole photographed

and vectographed with a print thereof being furnished each member of the demolition detail.

(d) It is of the greatest importance that a complete rehearsal of any destruction mission be enacted by all members of the detail and a relief map is invaluable for this purpose. Nothing important to the success of the venture should be left to guess or in uncertainty if it is reasonably possible to secure this information in advance. Each member should know what his actions will be in each of every reasonably possible contingency, and the element of time should be carefully computed, rehearsed, adjusted, and then as closely as possible maintained.

(e) Having become thoroughly familiar with the actual appearance of the terrain, and everything on it the way it will appear under conditions encountered during the effort, and with each member possessing this mental image and photograph for checking and refreshing, a detail's chances for success will be greatly increased.

(f) Photographs thus made that show or indicate the exact objective should never be carried by any member on a surface mission. The capture of one may trap other members and possibly defeat the mission of the detail. The image of the target itself and the exact location of various parts thereof must be carried only in the minds of the detail members, and this impression and image can best be gained by prior exacting study of a scale model thereof showing as much information as is available.

8. (a) Normally any industry vital or essential to the war effort of any country, warrants, and in time of war receives, active and

Fig. (d) Relief map models should be made and studied

passive armed defense. This factor of course becomes of first importance in planning the method of mission accomplishment. The type, size, disposition and quality of the defenses will determine whether the mission can be best accomplished by a raid, in which combat is expected and perhaps sought, or by stealth, silence, and subdued action.

(b) This manual does not attempt to cover that phase of a destruction mission extending from the departure to the arrival in the target area. As pointed out above, this may necessarily be accomplished in one or more of several means depending upon the situation. It is pointed out, however, as stressed in paragraph 7, that it is not only advisable, but essential to the success of such an undertaking to have each man know in advance exactly what he is going to do when the objective or target area is reached.

(c) This publication is intended to show and teach:

(1) Where to look for certain types of target areas;

(2) Type and disposition of normal defenses to be expected;

(3) How to gain actual admittance;

(4) Where the most essential machinery is normally located;

(5) How it is recognized;

(6) How, where and what to use to accomplish the mission of destruction.

9. (a) Wherever possible it has been attempted to illustrate two, and sometimes three, stages of destruction:

(1) TEMPORARY—Designed to render the machine or service ineffective for a period of from ten to twenty days. This stage of destruction contemplates that it may be needed and used by friendly forces within that time.

(2) INTERMEDIATE—When the use is to be denied the enemv for a period of from three to five months, but that repairs could be normally completed within that time.

(3) COMPLETE—This stage of destruction contemplates no further possible use to anyone of the entire plant or any portion thereof.

(b) The stage of destruction desired must be determined by higher authority and will normally consider the long range offensive or defensive plan of the area. Necessarily the stage desired must be made known to those engaging in the mission well in advance of "D" day and "H" hour in order that appropriate plans may be made and rehearsed.

(c) It is desired to bring emphasis on the value of knowing how and when to accomplish various stages of destruction, as this becomes more important in some situations than mere destruction itself.

10. (a) Demolition and incendiary agents may be applied against their target in two ways:

(1) By air action
[a] Bombing.
[b] Parachute demolition details.

(2) By surface action
[a] Reaching objectives by planned combat.
[b] Details reaching objective by stealth and deception.

(b) Obviously the inability to direct bombs from great height, with poor visibility, and under combat conditions, makes it almost impossible to hit a particular machine which may be the heart of the target activity. To achieve the same approximate results by aerial bombing, tons of explosives are required, as opposed to pounds in the hands of a trained and experienced man, with a few minutes access to vital machinery.

(c) Conversely, it is less difficult to get *over* a target area by plane than it is to get *into* the target area by ground forces. Each method has its proper place and advantage depending upon the general prevailing situation. Both may be used very effectively in joint operations.

(d) The more important an industry or factory to the enemy war effort, the more completely will it be guarded from unfriendly action. This very fact renders air action by parachute details, and ground action by stealth, so difficult and costly as to be almost precluded from consideration, except where aerial bombing or combat ground forces are unavailable, or where the nature and disposition of the target make the defense thereof difficult.

Fig. (e) Important industries will be carefully guarded

(e) It therefore appears from the above that the two preferred methods of reaching a target are:

(1) Aerial bombing

(2) Raiding teams prepared to reach the objective by combat.

(f) This manual does not attempt to discuss the methods of obtaining entry into the target area by ground forces. Except to caution generally that unless positive information is known regarding the enemy protective forces, it must be assumed that adequate protection exists, and plan sufficient strength to overcome this resistance during the actual demolition work and the return of the raiding party.

(g) More specifically this manual attempts to obtain two objectives;

(1) Teach ground forces the
[a] Why
[b] Where
[c] What and
[d] How of damage and destruction.

(2) Teach aviation commanders, pilots and bombardiers the distinguishing features and functions of important industries and activities, and to show why and where within a specified

target objective, bomb loads should be dropped in order to do the greatest amount of damage and destruction.

(h) In each chapter herein effort has been made to present a general discussion of the activity involved; then specifically treat the subject as it applies to the ground units interested in physical application of agents of violence, and then separately treating the same subject from the standpoint of an air attack by bombing or strafing.

Fig. (f) Japanese gravity type power dam

MATERIALS

GENERAL: Many types of destructive agents may be used by ground forces, but generally weight in relation to force must be of first consideration. The well-trained demolisher will be equally adept and thoroughly familiar with most agencies of destruction, including those self-energized, but he will be especially equipped with those agents of explosion and fire which offer maximum force, simplicity, safety and certainty.

EXPLOSIVES

1. TNT: Generally, it may be said that the explosive force per pound accompanied by the many other desirable military characteristics of TNT, identifies it as the best explosive for demolition missions. Its insensitiveness to shock and moisture make it ideal to carry on the rough and hazardous journey of the saboteur.

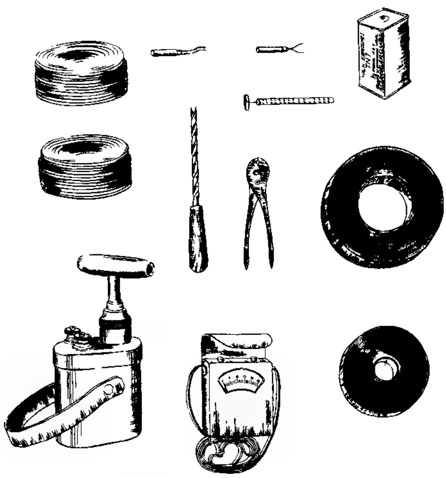


Fig. (a) Necessary demolition equipment

2. Detonating cord, tetryl caps, non-electric and electric safety fuse, lighters, a flash light battery, and scotch tape, make up the remainder of the explosive equipment necessary. A galvanometer, extra annunciator, wire, etc., may be carried by some members of the detail, but each man, or not less than each two man-team, should carry sufficient material to complete their portion of the mission independent of others.

3. The amount of actual explosive carried will depend upon the type and distance of the target, stage of destruction desired, and nature of intervening terrain. In general it may be said that every member of a small (10-15 man) detail should carry approximately eighteen pounds of TNT

or thermite, together with enough accessory equipment to explode or ignite same electrically and/or by time fuse.

4. Each detail should be made up of two man demolition teams and each team should be trained to work together, both in reaching the target area and in eluding or removing guards, and also must be thoroughly trained in the teamwork, so necessary to the rapid and accurate placing and detonation of charges.

5. Men on such details will rarely carry equipment other than small arms, ammunition, demolition equipment and emergency rations. Other field equipment will be discarded to lessen fatigue and increase speed and agility. It will almost always be found desirable or necessary to send covering or combat groups to accompany the actual demolition detail to assure the success of the mission.

Fig. (b)
Travel light

6. TNT should always be carried on the back, packed closely in a suitable haversack. Fig. (c) illustrates a pack designed to carry securely approximately 36 one-half pound blocks of TNT already fitted with detonating cord, and available instantly either singly or in various size charges. The pack is adjustable to permit the carrying of larger or smaller loads. It is recommended that the upper as well as the lower layer of TNT blocks be secured by passing electric or scotch tape tightly around the entire layer. See Fig. (c). This permits ease and speed in handling and in an emergency the entire pack load could be exploded by detonating one block.

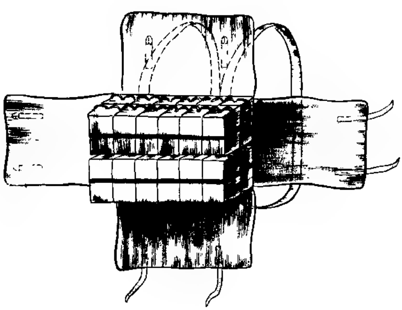


Fig. (c) Haversack for TNT and thermite

7. Each block of TNT should be previously prepared with detonating cord in order that no time will be required in this operation at the target. A

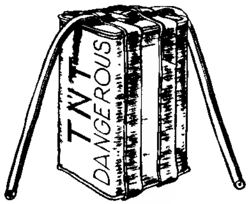


Fig. (d) Preparing TNT block

good method is to strip the outside covering from the cord for approximately eight inches, then doubling at the center point, and insert in TNT after reaming through to the bottom of the block. The two exposed ends should be about five inches long for joining purposes, and the cord secured in and to the block by scotch or electric tape as illustrated in Fig. (d).

8. Tetryl caps should be carried by each man in a sponge rubber case in his right front shirt pocket. A suitable case can be made of three-fourth inch thick sponge rubber five inches long and three inches wide. Cap receptacle pockets equally spaced 3/4" apart can be drilled or burned through the rubber. See Fig. (e). The caps should fit snugly and each open end of the case closed by tape. They are easily removed by pushing out with the finger. Electric caps can be carried in the same manner by wrapping the lead wires in small coils and taping to end of rubber case.

Fig. (e) Rubber cap case

INCENDIARIES

9. Thermite is a very effective agent of violence, which will in some instances, be more effective than explosives. It burns at approximately 5000 Degrees Fahrenheit, which is sufficient to fuse most metals and render them unfit for further service. It is easily ignited and has the added advantage of greater safety and comparative silence, which gives the saboteur a greater advantage in getting away. All men should be trained in its use, and details should always consider its value when estimating the requirements of their mission.

10. Thermite while in process of combustion is highly volatile and subject to some flow or dispersion, therefore should be confined as much as possible into the area where the damage is to be created. This can usually be done by a dike, cap or wall of mud, sand or other non-inflammable substance. In many instances the shape and construction of the machine being destroyed can be utilized to excellent advantage in confining the thermite, as will be shown in illustrations herein.

11. A thermite bomb can easily be constructed of any light container. Metal, wood, cloth, or cardboard are equally satisfactory, as the container itself is quickly consumed after igniting, regardless of its composition. The size of the bomb will depend upon the type of equipment to be destroyed and the ability to confine the thermite after ignition. Normally bombs of less than two pounds are ineffective on heavy machinery unless used in groups.

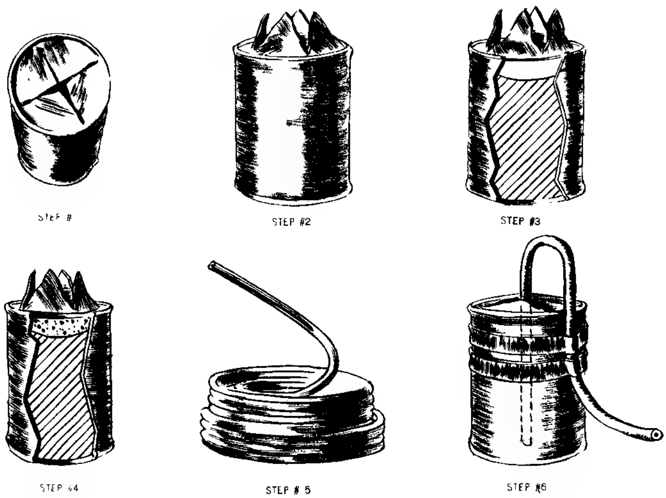


Fig. (f) Thermite bomb

Step 1. Open can,
2. Bend points up,
3. Fill 4/5 full with thermite, concaving center,
4. Fill remainder with starter compound,
5. Make incision to center of safety fuse,
6. Insert fuse to bottom of can and secure.

12. Production bombs or containers are no doubt available, but suitable substitutes may be quickly made by using an ordinary tin can. Fig. (f) with six steps, shows how to prepare a very satisfactory bomb which can be used in gear boxes, shaft bearings, hydraulic presses, igniting heavy oils, and in many other places. In making the incision in the safety or other fuse try to barely cut to and not into the combustible core. Handle as little as possible after cutting to avoid loss of the filler and consequent missfire of bomb.

13. Fig. (f) illustrates how to prepare a bomb with time or safety fuse, but where it is desired to ignite electrically the same steps will be followed using an electric squib instead of the fuse. In this case care must be exercised in loading so that the squib itself is in contact with the starter compound.

14. The cardboard covers from one-half pound TNT blocks, while small, make excellent Thermite bombs as their shape permits secure and compact stowage in a pack, and they are easily attached to machinery singly or in groups.

15. Starting compounds should be non-explosive and all bombs should have gas escape holes or slits close to the starter in order to avoid an explosion of confined gas when ignited. This would probably burst the bomb violently and scatter the thermite away from the area to be burned before ignition of same was accomplished.

16. An agent that is very effective in the starting of fires in warehouses, ammunition and supply dumps, etc., where a large area is desired to be fired, but where the intense heat of thermite is not required, or is too localized, can be made as illustrated in Fig. (g) and described as follows:

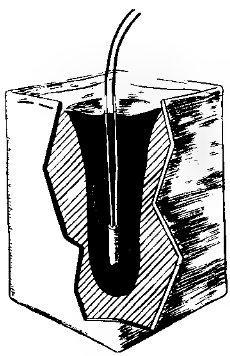


Fig. (g) Potash and sugar bomb

(a) Mix two parts sugar with one part potash and place in any suitable cardboard or other light container, leaving a hole down into the center, which is then filled with black powder. Insert a fuse with squib or electric squib in the black powder and secure the fuse with tape. Seal the top with paraffin, shellac, paint, glue, or other suitable substance.

(b) Pour sulphuric acid over the area where the fire is to be started and place the above bomb so that upon bursting particles thereof will be hurled over the area saturated with sulphuric acid. See Fig. (h).

(c) The union of the compound with the sulphuric acid instantly creates a fire of sufficient heat to destroy cased ammunition and to rapidly consume all combustible materials nearby.

(d) The sulphuric acid should be poured as soon prior to igniting the bomb as possible, and on substances that are not highly absorbent, as the compound must come into contact with liquid sulphuric acid for the best results.

17. A highly efficient incendiary bomb can be constructed where more time and materials are available, that is invaluable in starting larger fires in warehouse or dump areas. To make a one gallon (recommended size) bomb proceed as follows:

(a) Dissolve 22½ grams of Sodium Hydroxide in 225 cc's of alcohol, and dissolve 150 grams of stearic acid in 150 cc's of alcohol. Heat these two mixtures separately to the boiling point. Mix the two while stirring well and constantly. Boiling will immediately ensue but is not dangerous at this stage.

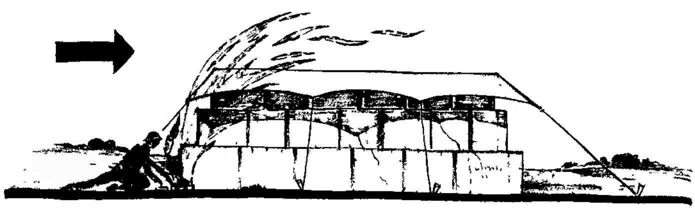
(b) When the mixture reaches a soapy consistency, cool and granulate by forcing through fine screen. Now add one gallon of ordinary gasoline and boil the mixture for approximately 10 minutes in a double boiler.

(c) Remove from heat and thoroughly mix separated particles of cotton waste, or other similar substances, into the mixture, and while cooling, but before jelling, pour into suitably sized cardboard container.

(d) Before jelling insert glass test tube of suitable length and diameter into the container and mixture with the open end stoppered and flush with outside of bomb. The bomb now only needs the test tube filled with black powder and a squib placed and secured therein to be ready. The powder should be placed when the detail is prepared for the mission, and the squib when the charge is actually placed at the target.

(e) Ignition causes the black powder to burst the bomb and to throw burning gasoline particles over a very wide area. This type of incendiary is ideal for starting fires in warehouses, stock rooms, supply dumps, etc., where some combustible materials are present, and where large areas are to be fired.

18. (a) In setting area fires out-of-doors always start them on the windward side.



Start fires on windward side

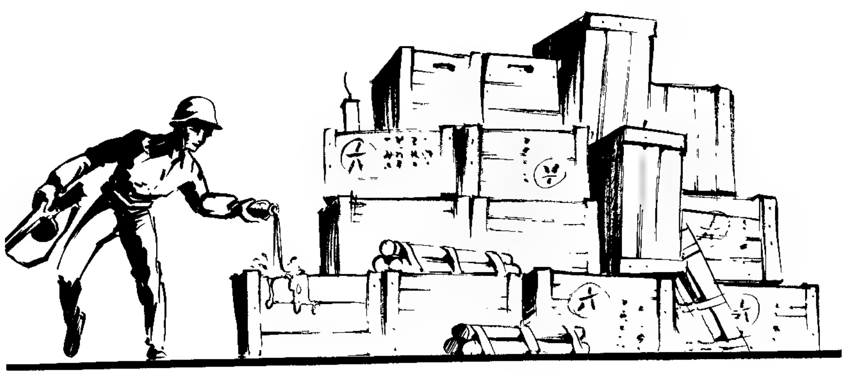


Fig. (h) Apply sulphuric acid and ignite bomb

(b) Wherever possible in order to insure success with fires in warehouses or other buildings knock out windows and doors low on the windward and high on the lee sides of the building, and start the fire on the windward side. This introduces a draft that supplies oxygen for the fire and exhaust for hot spent gasses.

19. Always attempt to start a fire where it will be most difficult to extinguish, providing, of course, that a good draft of air is a first requisite. Fires normally cannot be efficiently fought from the lee side, and ammunition, gasoline, etc. placed strategically on the windward will deter the most courageous efforts to extinguish the fire when they begin to explode.

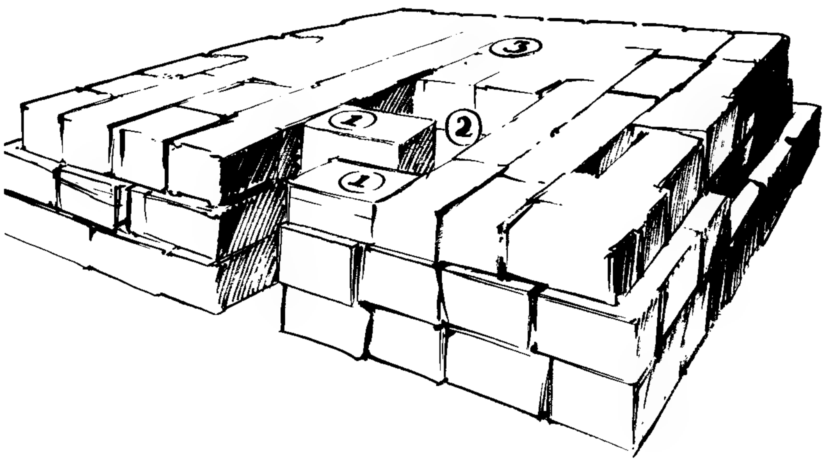


Fig. (i) Rearrange supplies
(1) Baffle walls of inflammables
(2) Start fire here
(3) Place cans of combustibles here

20. If time permits some rearrangement in the warehouse or dump area, efforts should be made to erect a baffle wall or series thereof, of ammunition, gasoline, or other highly combustible materials, as shown in Fig. (i), on the windward side of the place where the fire is to be started. This precludes close human approach to the fire, and makes the application of water or chemicals to the flame very difficult. If possible the passage-way around the baffle walls should extend from the top of the supply pile to the floor.

21. If available, cans or drums of gasoline or oil should be placed around the top perimeter of the area where the fire is started. If efforts are made to extinguish the flames with water, these cans will be knocked down into the fire and exploded, and if no effort is made to extinguish, they will become heated and upon bursting will throw burning liquid over the entire dump.

MISCELLANEOUS

22. Men that are specially trained in the use of explosives and incendiaries will find that many devices can be constructed or improvised from materials at hand, that will assist in the destruction program. For example, if a safety fuse is not available, candles may be used as a means of igniting either incendiary or explosive charges or powder trains.

23. A cigar or pencil type incendiary can be constructed by the use of a small length of lead pipe. A copper disc of varying thickness should be welded in the center of the pipe area, and one end filled with sulphuric

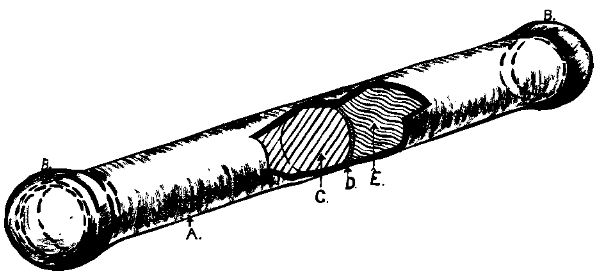


Fig. (j) "Cigar" or "pencil" bomb
(a) Lead tube
(b) Lead plugs (soldered)
(c) Picric acid
(d) Copper disc (soldered)
(e) Sulphuric acid

acid,.and the other with picric acid. Each end after filling should be plugged with wax and lead cap in order to make the same air tight. The sulphuric acid will eventually eat through the copper disc, and upon gaining contact with the picric acid will explode with considerable force and produce a flame of intense heat, sufficient to ignite any combustible material nearby.

24. This type of bomb would have to be constructed prior to starting on the mission, and the thickness of the copper disc would have to be predetermined in order to establish the approximate time at which the explosion would take place.

25. The chemicals which should form a part of the equipment in the training area, as well as in the actual theater of operations would be:

(a) Phosphorous
(b) Metallic Sodium
(c) Permanganate of Potash
(d) Glycerine

26. Some of the more inflammable liquids with which all men engaged in this work should be familiar are:

(a) Gasoline
(b) Kerosene
(c) Solvents
(d) Alcohol
(e) Carbon Bisulphide
(f) Paint Thinners
(g) Acetone

The principal characteristics, such as appearance and odor, as well as behavior of these liquids, should be well known in order that they will be quickly recognized when found in enemy areas and put to valuable use.

27. Illuminating gas is lighter than air, and, therefore, rises upon release. A candle may be safely lighted at floor level while illuminating gas is turned on in the same room or area. If all windows and openings are closed, the gas will eventually build down to the flame level and will then explode. In this manner fires can be started or explosive destruction accomplished with little danger to the demolisher.

28. Some gases are heavier than air and descend, and, therefore, the character of the gas must be known before setting an explosion in the manner described above. All illuminating or fuel gases, natural or manufactured, are lighter than air and therefore, may be safely employed in the above manner.

TRAINING

1. Commanders must realize that the nature of successful demolition operations is such that men, untrained in its many special requirements, cannot be chosen, or allowed to volunteer, when the need for effort of this nature arises. This fact must be observed and prepared for in the training area.

2. The value of careful selection of men cannot be over-emphasized, and it must be apparent to all that the hazardous, technical, and arduous nature of these missions require men whose training has been carefully planned and supervised in every detail.

3. As stated elsewhere herein, men should be selected for their resourcefulness, agility, endurance and courage. This selection should take place in the training area and then the men formed into teams or details and train together as such, in order to perfect the element of teamwork so necessary in operations of this nature.

4. No attempt is made to outline exact courses of training herein but certain definite steps are stated and should be followed:

> (a) A complete course in explosives, incendiaries, and demolition preparation is a prerequisite to any other special training. This

Fig. (a) Men must become adept with explosives and incendiaries

course should embrace the handling, preparation, calculation and ignition of all normal types of explosives. It should also include the making and application of various types of incendiary bombs.

(b) The handling and use of explosives present an abnormal mental hazard to most men untrained in its use, and it is absolutely necessary that sufficient materials be expended to permit each user to overcome this complex. Nervousness and indecision in the use of those agents, added to the other hazards always present on a mission of this character, are almost certain to have a very detrimental effect on the success of the undertaking. Blowing simple craters has some value but the actual demolition work must include projects of more complex character. Those responsible for the training should make contact with powder companies and state and county engineers and request to be notified in advance of coming major projects employing explosives, in order that the students may be allowed to witness, and possibly participate therein.

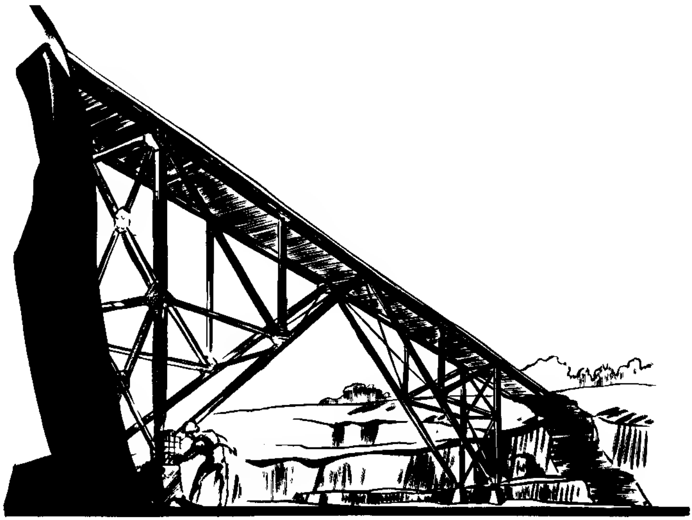


Fig. (b) Actual subjects should be used wherever possible

(c) Carelessness and bravado in the handling of explosives in the training area should be treated in the same manner as when evidenced on the firing line of other weapons. Every student of demolition should possess such a degree of proficiency in the use of explosive agents, that he is constantly alert to their inherent danger, while thoroughly familiar with their tremendous power.

(d) Men should be trained in the proper calculation and placing of complete demolition installations, day and night, on bridges, culverts, and if possible by prior arrangements in factories, etc. Regular TNT blocks should be used—but sash-cord substituted for safety fuse and detonating cord. Caps can be easily made from cardboard, but all other equipment should be standard; or wooden dummies of TNT blocks may be used and have all other equipment regular. The explosion of a cap within a wooden block will demolish the block, but nothing else, though naturally dangerous to careless personnel.

Fig. (c) Thorough training in scouting and patrolling is necessary

(e) Each man should be well-trained in scouting and patrolling in order that cautious and concealed motion, and the many other requirements of this science will be second nature to him.

(f) He should be conditioned by strenuous physical exercise, particularly by long cross-country hikes at night with full loads of equipment. Most of his training should be after dark because in the actual target area most of his effort will be between darkness and dawn.

(g) A thorough course in hand-to-hand fighting is absolutely necessary, as the demolisher must be capable of dealing quickly, quietly and decisively with anyone who attempts to, or may interfere with, the successful completion of and return from his mission. His knowledge and proficiency in this method of fighting must be

sufficiently great to cause him to prefer and choose this quieter method of fighting in enemy territory, where stealth may be required.

Fig. (d) Long hikes at night should be a part of the training program

(h) Possibly the greatest advantage of a highly developed ability at hand-to-hand fighting is the psychological effect upon the individual. With it fear of darkness and possible ambush is substantially reduced, without necessarily decreasing the knowledge of constant need for caution.

(i) Actual demolition and destruction missions should be executed in the training area with as many combat conditions introduced as possible. These should be performed at night and wherever possible over unfamiliar terrain. Where possible an objective should be assigned that can be actually destroyed.

(j) Men should be thoroughly trained in map reading, sketching, aerial photo interpretation, and relief map construction and use.

5. In addition to the general subjects listed herein, the training should embrace the contents of this Manual, and particularly those chapters to follow which deal with specific industries and activities of strategic importance to any nation engaged in the pursuit of war.

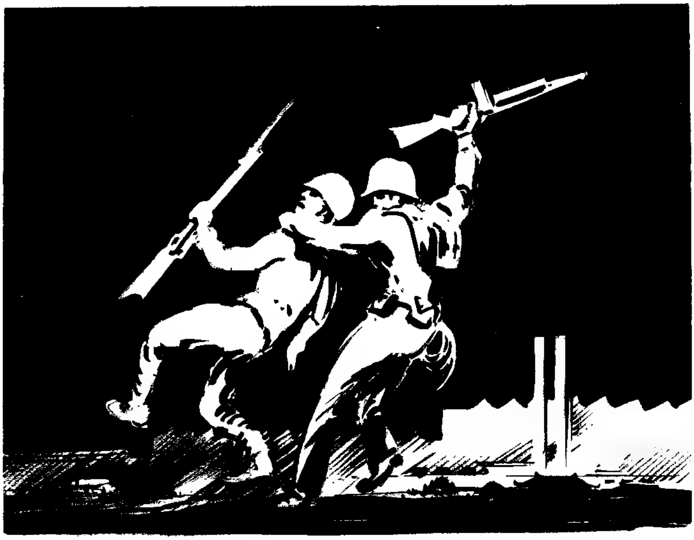


Fig. (e) Hand to hand fighting is necessary

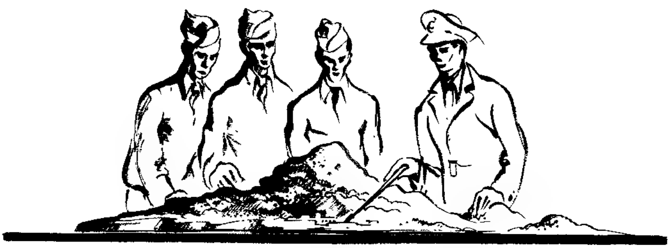


Fig. (f) Relief maps are important in the mission

ALARM AND PROTECTIVE SYSTEMS

1. Generally, any activity of sufficient importance to the enemy to justify its damage or destruction by friendly forces, also justifies elaborate protective systems installed by the enemy. These can be divided generally into two groups:

(a) HUMAN

(b) MECHANICAL

2. HUMAN SYSTEMS will usually include:

(a) Civilian armed guards, comprising the plant police force. This is usually a very highly trained and efficient group of men, thoroughly familiar with the plant and the protection thereof from within, rather than the resistance of a well-armed military force from without.

(b) Depending upon the size of the plant and its importance, this guard may vary from 10 to 400 or more men, with approximately twice the number on active duty while the plant is in actual operation as when it is operating at only partial capacity. Normally one guard is on duty constantly at all outside gates, or other entrances while same are unlocked.

(c) Armed guards check all incoming shipments by train or truck before actual admittance to the plant proper. Guards are usually stationed in and around a plant so that all outside fences or walls are under constant surveillance, and the interior and exterior of all buildings are observed at least once each hour.

(d) Critically important units of machinery, or other important installations, are under constant guard. At night where exteriors are unlighted for blackout purposes, guards are sometimes doubled and additional mechanical devices made operative.

(e) In addition to generally adequate interior armed civilian guards, most essential plants will be defended from without by military forces. Depending upon their location, these will usually consist of anti-aircraft guns, and/or ground defense forces.

(f) These defenses are usually adequate for such effort as may be normally anticipated, and the element of surprise regulates in a large measure the success of the undertaking against the object they defend.

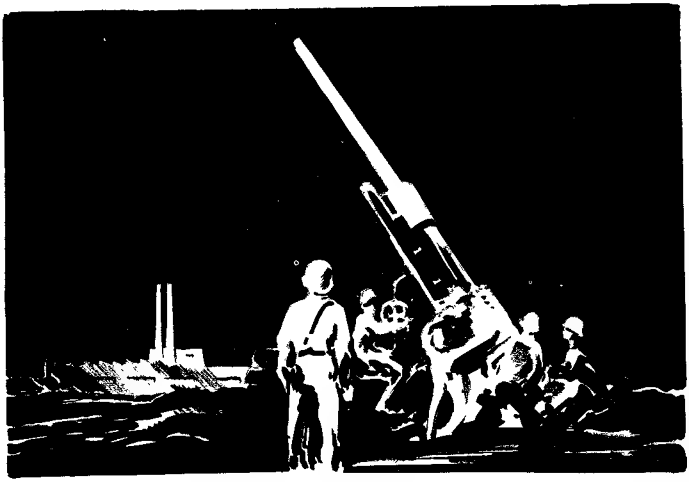


Fig. (a) Military forces will guard important industries

(g) If the location and composition of defensive forces are unknown, more effort is required in order to insure success. If surprise cannot be gained then, if possible, the mission should be planned in a manner not normally anticipated by the enemy, and by a force of sufficient strength to overcome unexpected resistance.

(h) As has been stated elsewhere herein, it will probably be necessary in most surface destruction missions to send a substantial covering or combat force with the actual demolition detail, but care must be exercised to send no more than actually necessary.

3. Mechanical Systems:

The armed civilian and the military guards rely principally upon the visual and hearing acuity of its members, but the better protected plant will employ a multitude of mechanical devices to assist them in detecting the presence of unauthorized persons, and in spreading a general alarm throughout the immediate plant, as well as to local military and police military and police headquarters. This latter fact must always be recognized in planning the execution of a ground mission of this character, and extreme care exercised to avoid the actuation of an alarm, or otherwise be prepared to overcome the additional resistance summoned thereby.

(a) Most important of these systems is the central control board located usually in the police or guard headquarters, in or near the administration building and the main gates. This station controls all others within the area, flashes warning lights or bells from interrupted electric eyes, contains the plant general alarm devices, the loudspeaker system, and usually has direct contact with local military and police headquarters.

(b) This system should be put out of operation early in the effort, to prevent communication outside or inside the plant. This can be accomplished quickly and effectively by first disconnecting the power switches, usually located on or near the panel itself. These plants normally secure power from the general plant circuit for regular operations, and almost always have a separate standby battery or generating set, which automatically cuts in when the primary current fails. This standby power unit will be located in or immediately adjacent to the room containing the control panels.

(c) With control of this room in friendly hands and with the outside circuits disconnected, the amplifying speaker system may be employed to direct destruction and escape activities over the entire plant area.

(d) Many plants employ the electric eye, or photo electric cell, to flash a warning when the beam is interrupted, to the master plant control board, or to ring a bell alarm in the area. This is an electrically operated device which depends upon the general plant circuit, and which fails with the failure of the primary system. It normally does not have an automatic standby emergency power source of its own, and therefore is inoperative between the failure of the primary power and the cutting in of the general plant standby system. However, it must not be assumed that destruction of the primary power source will render these devices useless because in very critical areas such an plan vaults, transformer rooms, and other seldom frequented places, an auxiliary power system may cut in automatically upon failure of the primary system. Even where combat is expected and sought in the execution of a mission, it is [illegible] to use caution in entering these critical areas as the "eye" alarm may be directly connected to nearby military establishments and will spread a general alarm, summoning resistance of overwhelming proportions.

(e) The photo electric cell is placed across openings which normally must be crossed to gain entry into vulnerable areas. Extreme caution will cause discovery of the light cells if the visible ray is employed but it is almost impossible to discern the newer "black" or "invisible ray" source of cell activation.

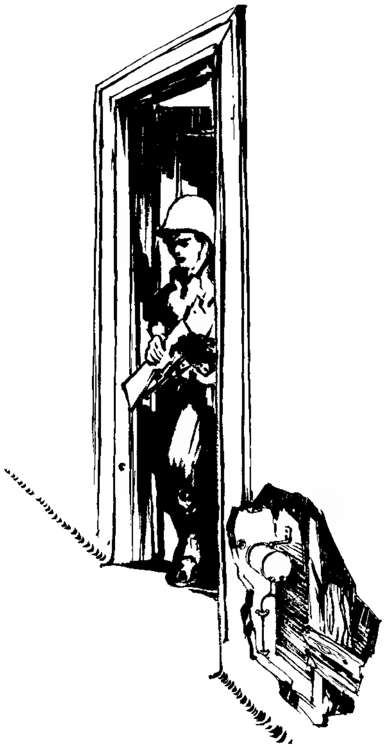


Fig. (b) Electric eyes guard critical passages

(f) The cell is normally inoperative over distances greater than 15 to 20 feet, therefore it is in the narrower areas where it must be avoided, if stealth is necessary. It is necessary to crawl on the stomach to avoid detection by an "eye" as it is usually located about 15″ from the floor or ground. Particular care must be observed just outside or inside doors leading into critical areas. Remember that the "eye" is designed to be a silent watchman over areas not normally otherwise guarded.

4. Usually all plants will be completely fenced with non-climbable fence of wire, stone or concrete and can be flood-lighted instantly manually or automatically.

(a) Outside fences in isolated areas are sometimes charged with destructive voltages, or with a circuit which grounds upon contact with a body and sets a signal or alarm in motion.

(b) Examine the fence at posts and at the ground line for insulators to determine the presence of current. Do not touch any portion of the fence until its character is known. Cut only those wires known to be non-conductors of an electrical current.

(c) Where the conventional woven type fence is encountered, it is

better to cut out a section three or four feet from the ground and as wide as necessary to admit the detail with equipment and then bend this flap and secure. See Fig. (c).

(d) Always leave one man at each opening to keep it open and free for escape, and to guide the detail back to it by prearranged signal if necessary.

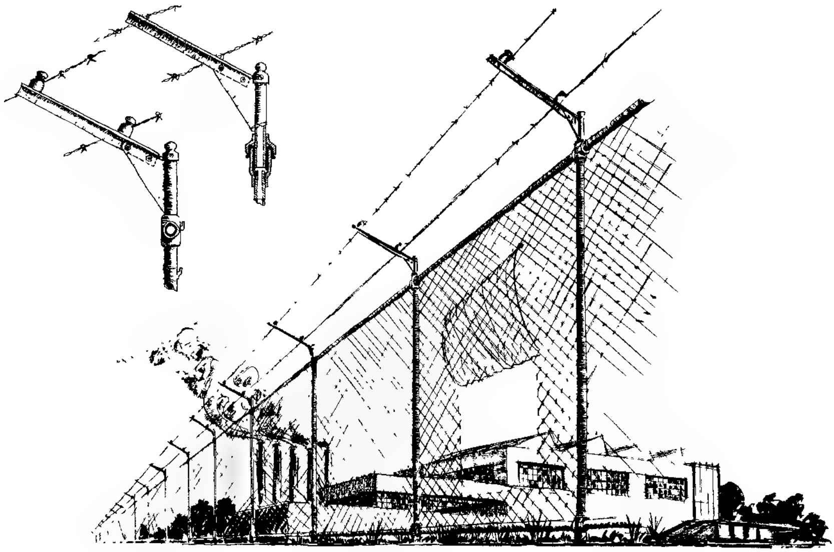


Fig. (c) Fences must be inspected carefully

(e) It is better to make a new opening in a fence or wall than to tamper with an existing gate which is locked or otherwise secured, unless carefully examined first to make certain no alarm system will be actuated by the breaking or opening thereof.

5. Usually any protective system, human or mechanical, has a period when its efficiency reaches a point lower than normal, and this should be considered in the attack plan wherever possible.

(a) Human systems are less efficient in the hours between midnight and dawn; on, or immediately before or after holidays, or days of ceremony and religious observance; during the dark of the moon; inclement weather, and during the middle of a watch.

(b) Mechanical systems are less efficient during daylight hours, and while a plant is in full operation. Less notice will be paid to

bells, lights and other visible or audible alarms during daylight and they are less noticeable when many other noises and lights are in operation.

6. It is apparent that the many intricate and effective systems of protection and alarm make it nearly impossible to gain entry in numbers to an industrial area without being detected and possibly overcome before the mission is completed. It is also obvious that these raids must generally be made in sufficient force to overpower the local guard system and to cover the men actually engaged in the destruction work, against other military, police, or civilian forces that may be summoned from the immediate area, until they have finished their work and completed their retirement.

7. Against smaller or isolated plants the raid by stealth may function satisfactorily, but on larger and more important objectives it would appear necessary to proceed in force as cautiously as possible to the areas immediately around the objective and then, if necessary, gain admission by combat, immediately thereafter setting up a defense for protection while the work of demolition is carried out.

8. Raids in which aircraft and ground troops combine offer advantages worth consideration. In the confusion and destruction immediately following a bombing attack a well planned surface raid could complete the mission by demolishing essential machinery undamaged in the bombing, and by preventing the extinguishing of critical fires. The period of blackout that accompanies an air alarm or actual raid, is an ideal time for a surface detail to go into action.

9. Hydro-electric power stations are almost always located in a remote section of the country and they are normally guarded by fewer civilian guards and military forces, consequently they offer the least resistance or possiblity of detection while approaching the area.

10. Water storage and pipeline systems, oil fields, mines, and sometimes refineries are located away from centers of population, but normally all other industries of vital importance to the war effort of any nation will be located close to or in congested areas. This fact, while serious to the effective planning and execution of a surface raid, becomes a distinct advantage to the aerial mission of destruction.

POWER

GENERAL:

1. Power may be said to be the key of practically all industrial activity, and to diminish or to destroy it, will definitely strike a serious blow in the war production program of any nation. Electricity is the principal source of power, with the electrical current therefor, developed through the force of steam, water or internal combustion engines. Steam and hydraulic force develop the large majority of power throughout the world. Internal combustion, gas or Diesel, engines supply a small portion of the regular demand, and in recent years have been utilized to a great extent as a standby source of power.

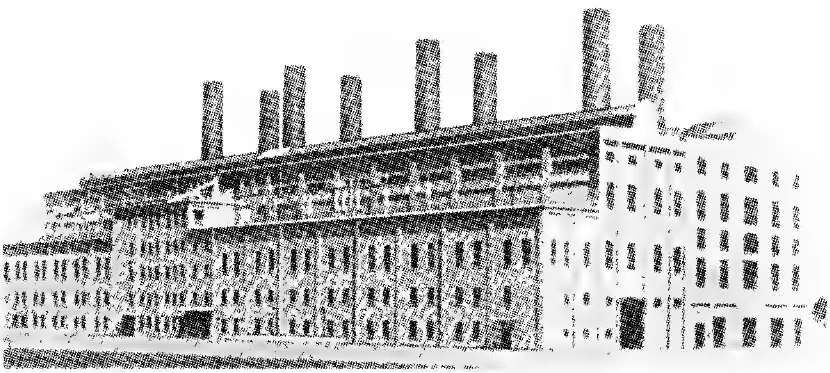


Fig. (a) Power plant in Japan

2. In view of the fact that electricity, by whichever method developed, provides the power for the operation of the large majority of machines, services and activities, vitally important to any nation engaged in war, it becomes important that the subject be covered as thoroughly as possible herein, and studied with great thought and care by those interested, or being trained, in the science of demolition destruction.

3. Throughout this manual, and almost any industry not covered herein, it will be found that the power installation is, in practically every instance, the heart of the industry's activity.

4. Normally within a metropolitan or a larger area, there will be several sources of primary power fed into a common grid system. The power may be developed by hydraulic electric plants in the mountains, by steam plants near fuel sources or in metropolitan centers, or by internal combustion engine plants located where the power is consumed. All of these plants, whether government or privately owned, are usually interconnected to this grid system, and this system in turn is probably connected by long distance transmission lines to the grid systems of other large areas.

5. This principal source of electrical energy is normally consumed by the usual domestic requirements, with large portions consumed during the domestic off-peak periods by industrial or manufacturing establishments.

6. In addition to this outside source of electrical energy, most manufacturing establishments also maintain their own power system. This may be used as a primary, supplemental, or standby source of power for their requirements.

7. Therefore, if certain industries are to be isolated from a source of electrical energy, it almost becomes necessary to destroy not only the plant within the industry itself, but also the principal power supply sources within the grid system.

8. Probably no greater damage could be done to the industrial productivity of any important area, than by a well-organized surface or air raid, directed against one or more of the principal power producing units within an area grid system.

STEAM ELECTRIC POWER

9. Steam power plants depend upon large quantities of some type of combustible fuel for their operation, and therefore are invariably located near the fuel supply, or near a carrier upon which it can be transported. Coal, wood, and sawdust are typical fuels that require substantial railroad or ship transportation facilities; and a power plant of this type will ordinarily be located in or near a city, on a railroad or waterfront. Other types of fuel, such as gas or oil, are usually piped in and these plants are therefore not dependent upon a mobile carrier for their fuel requirements. However,

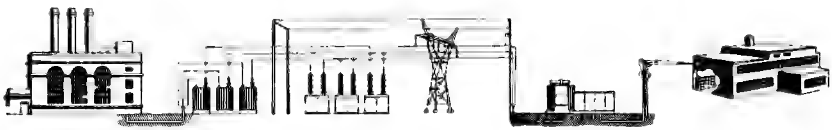


Fig. (b) The flow of power

the tremendous size and weight of much of the equipment employed in a steam electric power plant requires that it be constructed on a railroad or waterway, in order to be near a carrier of sufficient capacity to handle the initial equipment installation and replacement requirements.

Fig. 1. Coal-fired steam electric powerhouse

10. It is normally less expensive to pipe an oil or gas fuel supply to a metropolis where the power is to be consumed, than it would be to build

Fig. 2. Turbine room with control panels

the plant at the source of fuel supply and transport the power by transmission lines to the metropolis. Therefore, steam electric and Diesel plants are almost always located where the principal portion of the power is consumed, in contrast with hydro-electric plants which are always located at the source of the water power.

11. Steam power plants present a similar profile the world over as the tall stack, or stacks, are generally the dominating feature thereof. Where the plant is located near populated centers, and the stack fumes would be objectionable, they are by legislation or choice constructed very high. Short stacks with blower devices are cheaper and equally satisfactory to use and therefore where fumes are not a problem, stacks may be low, and a low overall profile will be presented.

12. A typical coal-fired steam electric power plant is illustrated in Fig. 1. This plant utilizes eight boilers in the tallest building, probably four or five steam turbines in the middle building, with the switchhouse and controls centered in the building nearest to the switch and transformer yard. This plant is so typical in appearance that it could be located in Manchukuo or Manhattan.

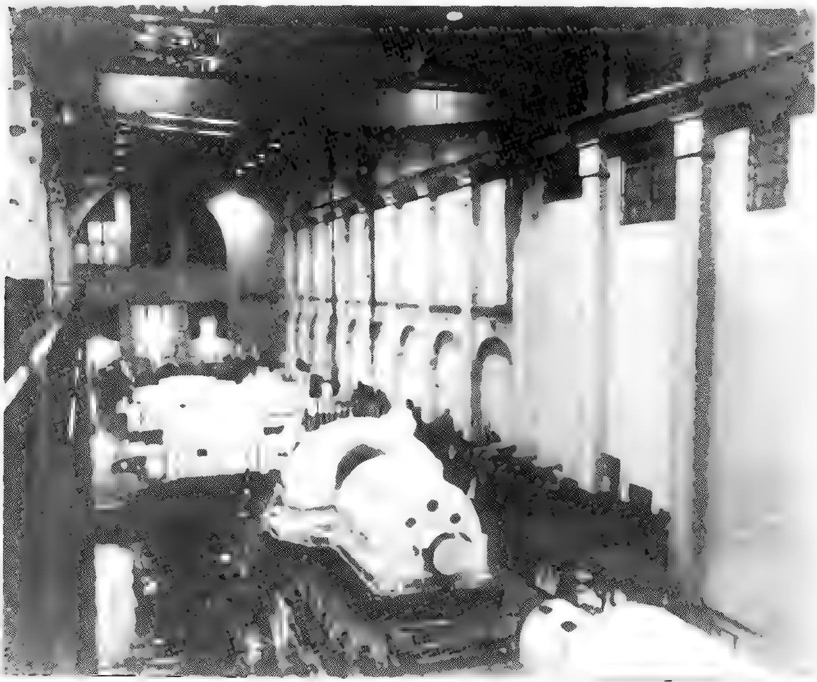


Fig. 3. Turbine room showing overhead crane

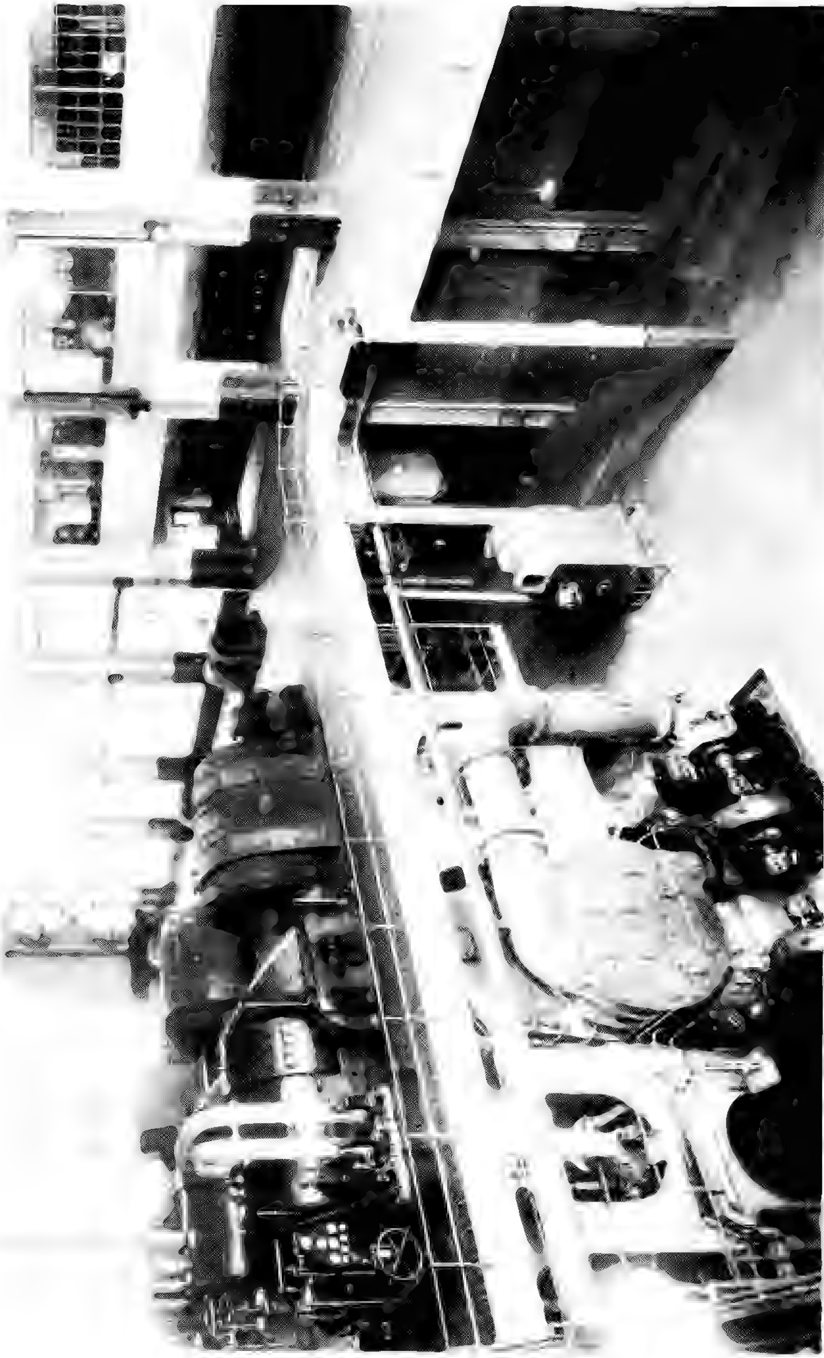


Fig. 4. Turbine and control room with condenser below

13. The appearance of a moderate-sized steam turbine installation, with the control panels located in the same room, will be seen in Fig. 2. These turbines are located on an elevated floor with the condensers on the level beneath. Typical turbine installations will be shown in succeeding paragraphs but in Figs. 2 and 3 an opportunity to visualize the overall turbine room appearance is furnished.

14. The boilers are usually located in a separate or attached building, as close to the turbines as possible to conserve steam heat losses.

15. In Fig. 4 will be seen a typical installation of three 20,000 KW turbines and generators with one condenser beneath. The one condensing unit obviously handles the two nearest turbines, and possibly the third turbine in the background.

16. The switchhouse and control booth are shown on the right of Fig. 4. The boilers are located in the boiler house off the left of the picture in order to be as near as possible to the turbines.

17. Figs. 5 and 6 illustrate two views of a large steam turbine and generator. On the right of Fig. 5 is the steam control apparatus with overhead governor and steam chest. Next is the turbine consisting of high and low steam pressure units connected by a gooseneck, and on the left will be seen the large generator. Fig. 6 pictures the generator and exciter end of this same unit.

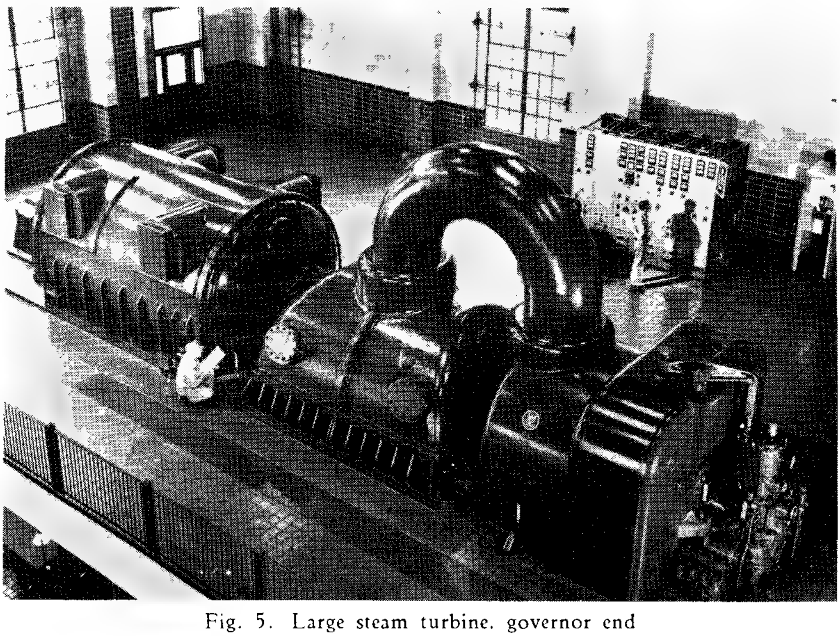
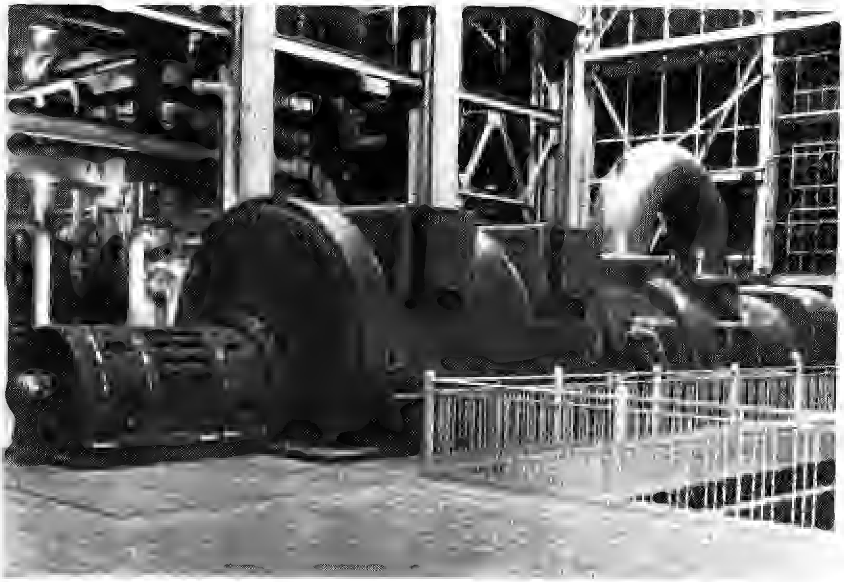


Fig. 5. Large steam turbine, governor end



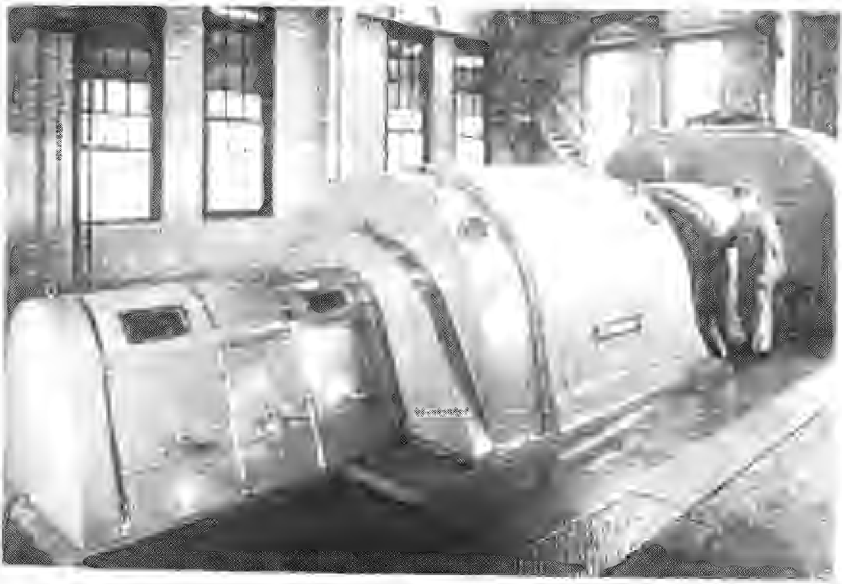


Fig. 7. Modern steam turbine

18. In Fig. 7 is shown a smaller installation from the exciter end, and which is typical of modern medium sized power installations throughout the world. This figure offers a good illustration of the generator interior

inspection windows, and the two windows on the left end of the shaft are for the inspection of the pilot and main exciters, and the generator bearing.

19. Another very modern installation is illustrated in Fig. 8 and here the back of one of the boilers in the adjoining building is visible. Later in this chapter discussion will be held on turbines and exciters, but it is advisable to learn at this point that while exciters may be installed in-line with generators they are not always on the same shaft. Therefor no attention should be paid to the destruction of the bearing contained on the extreme exciter end of a turbo-generator installation. If bearing damage is to be attempted, the bearings between the generator and the turbine, and on the exciter end of the generator, are the two which should receive attention.

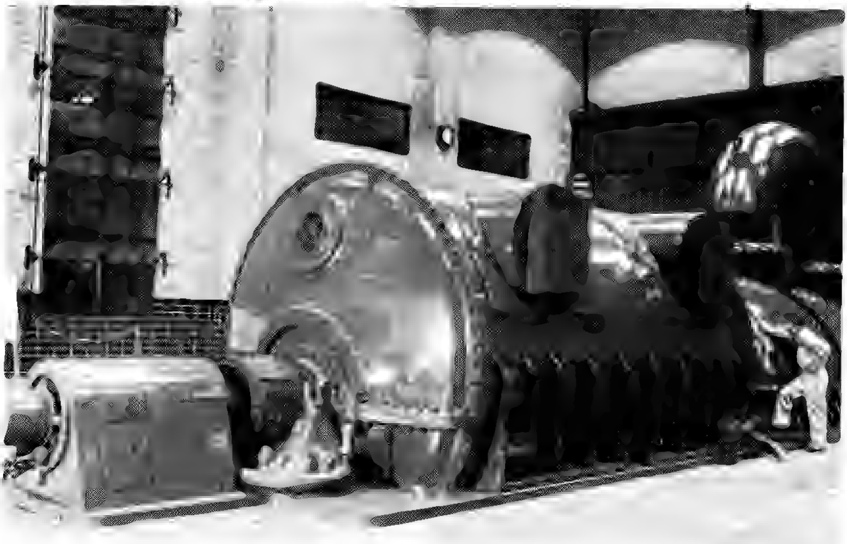


Fig. 8. 45,000 KW hydrogen-cooled generator

20. An older type of installation, and one which will likely be encountered in Oriental countries, is illustrated in Fig. 9. This is a 5000 KW turbine built over the condensing unit, and is a type of installation made between 1910 and 1930. The governor mechanism showing the speed changer handwheel, the overspeed trip with resetting handle, and the hydraulic controlled throttle valve, are all clearly and easily identified therein. The hydraulic and lubricating oil pump is shown in the right foreground.

21. Figs. 10 and 11 illustrate an overall and a closeup of two typical direct current generating units. These are somewhat older style units and many are in current use through the Orient. Here the steam chest and

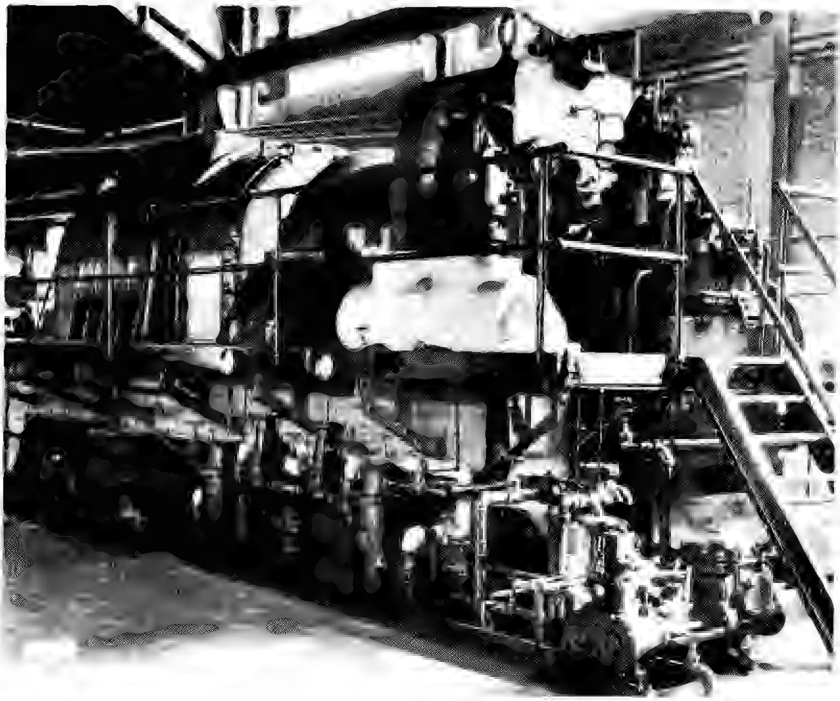


Fig. 9. 5000 KW turbine and condenser

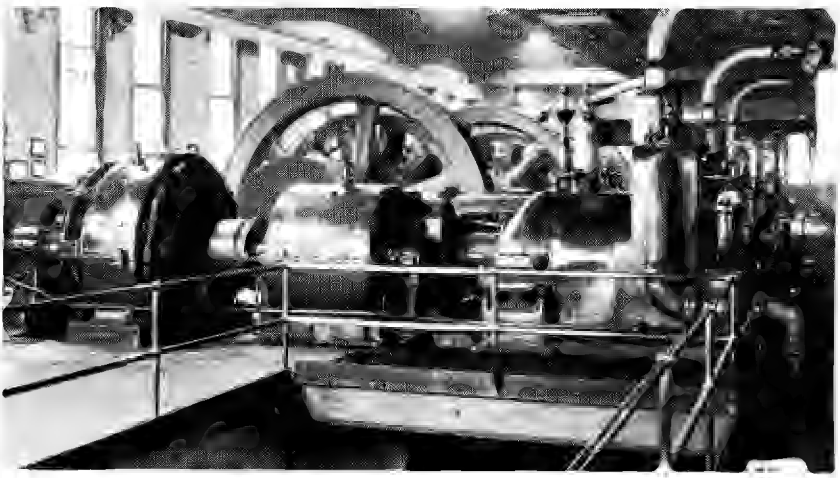


Fig. 10. D. C. geared turbine generator

throttle valves, as shown in Fig. 10, are essentially the same as in the new type AC installations, but the governor is of the older style fly-ball type.

Later in this chapter will be discussed the method by which governors can be blocked open to complete one step in the destruction of generating units through their own power. Where this type of governor is encountered, it will be necessary to block open not only the governor-T, as will be explained later herein, but also the fly-ball arrangement should be wired or tied down, and the auxiliary overspeed trip rod disconnected.

22. The generators shown in Figs. 10 and 11 operate through a gear mechanism which usually steps up the speed of the generator ten to twenty times that of the turbine speed. These gears therefore become especially vulnerable and should be destroyed. The gear box house and ventilator is shown in detail in Fig. 11, and it is here that some destruction should be undertaken. The casing is usually forged and therefore difficult to break by sledge. The ventilator, however, could probably be knocked off and various pieces of steel or small tools dropped into the gears through the opening. If thermite or TNT were placed on the bearing cap shown in Fig. 11, the entire gear mechanism would be ruined.

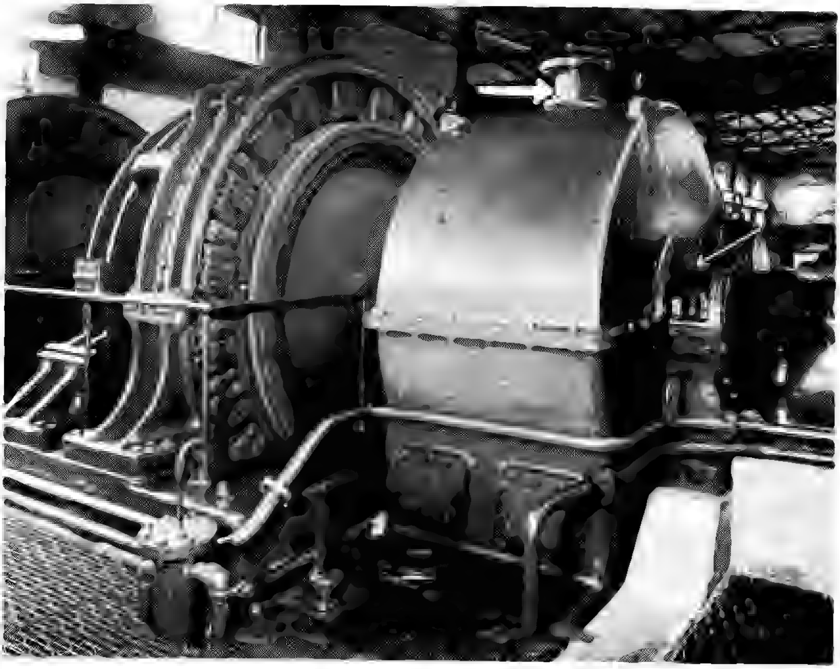


Fig. 11. Gear box and generator

23. The exposed windings on the generator are easily shorted by firing a few rounds into the armature and rotor, but a more complete job of

destruction could be done by throwing or inserting a metal object between the generator rotor and the armature while the generator was turning. In this connection it must be pointed out, however, that while this produces a short which probably automatically disconnects all switches in the circuit, for an instant it would be extremely dangerous to any person in actual contact with the generator.

24. In Fig. 10, and on the extreme right of Fig. 11, is shown the turbine rotor bearing as it emerges from the turbine housing. This is an extremely vulnerable spot for attack by thermite or explosive because even the slightest damage to the bearing surface of the rotor itself at this point would disable the entire generating unit until another rotor could be installed, which would require a period of at least six months.

25. It is emphasized that all power plants have their own individual characteristics, varying with the size and requirements of the plant, and the number of generating units and auxiliaries, but with certain minor exceptions most steam generators operate upon the same principal. The overall appearance may vary in some cases to a substantial degree, but a general understanding of the methods of steam turbine construction and operation will be sufficient to permit the employment of the same destructive methods on any installation.

26. Turbines are ruggedly built to withstand a high steam temperature and pressure, and great centrifugal force, and while subject to many minor destructive influences which may disable the unit for a few days, there are only two or three practical methods by which it can be permanently put out of operation.

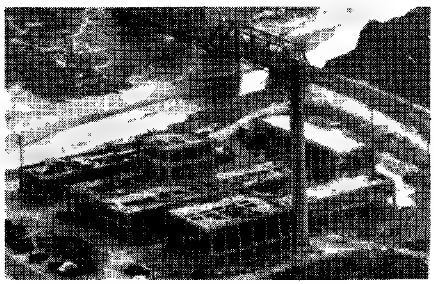


Fig. 11a. Damage caused by bursting turbine

27. Probably the best and most complete method of turbine destruction is to assist it to destroy itself. This is a relatively simple operation to one understanding what is required, and can be accomplished by the following procedure:

(a) Accelerate the speed of the turbine by opening the speed control hand wheel;

(b) Block wide open, preferably with a metal bar or heavy block of wood, the T-Governor regulating the flow of steam through the steam chest;

(c) Secure the overspeed trip so that it will be inoperative. This can be easily accomplished by simply wiring the resetting handle in its present position;

(d) Disconnect any auxiliary overspeed trip with which some turbines are provided;

(e) Block open the throttle valve if it is hydraulically operated;

(f) Remove the load from the turbine by shorting the generator with explosives or small arms fire through the inspection windows;

(g) Get clear of the area.

Fig. (c) A coal fired steam power station in Japan

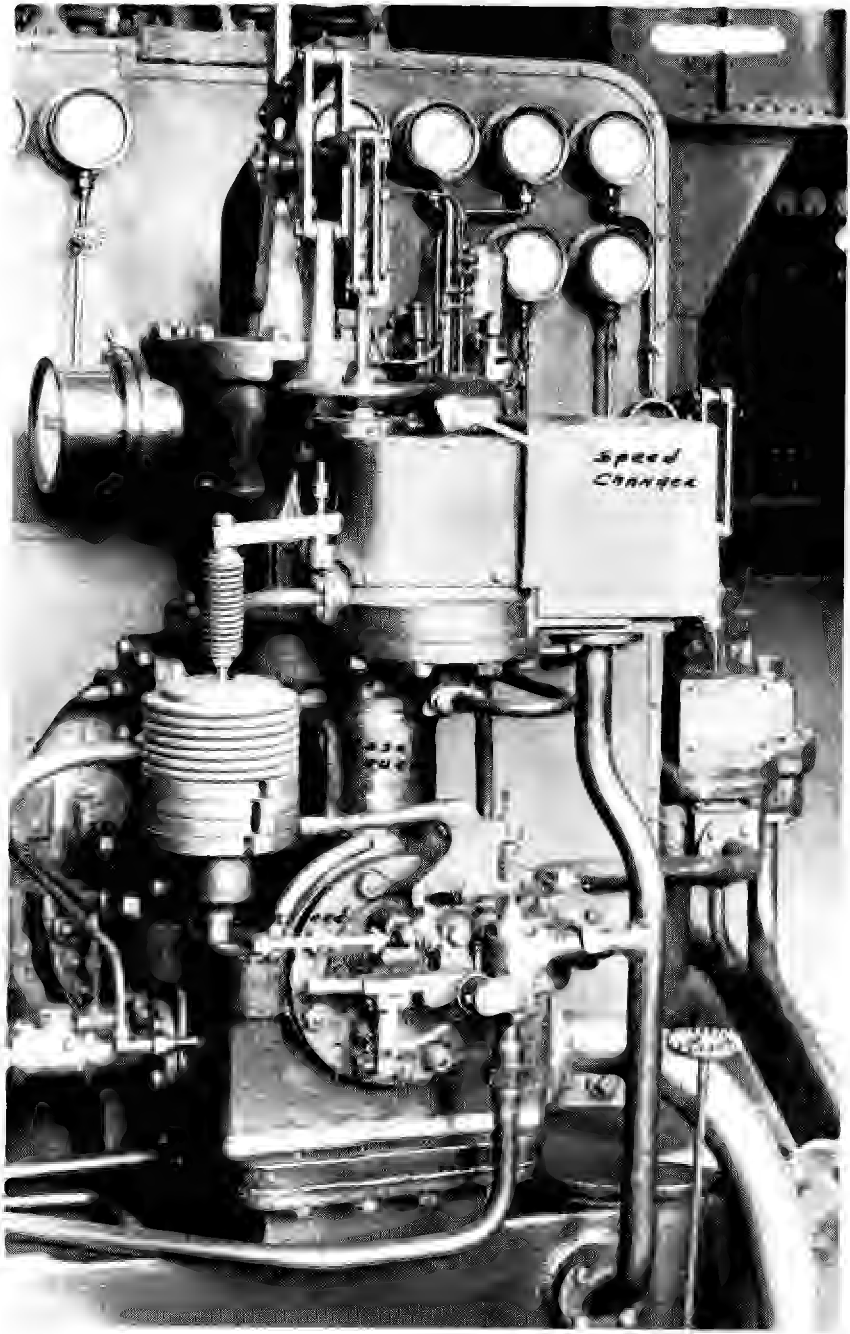


Fig. 12. Turbine governor showing speed charger and overspeed trip

Providing the steam supply continues undiminished, the turbine will develop sufficient speed within five or ten minutes to practically disintegrate. This process takes the form of an explosion which normally is of sufficient force to level or destroy the building and its contents. Fig. 11a illustrates the damage caused to one plant by the explosion of an over-speeded small turbine.

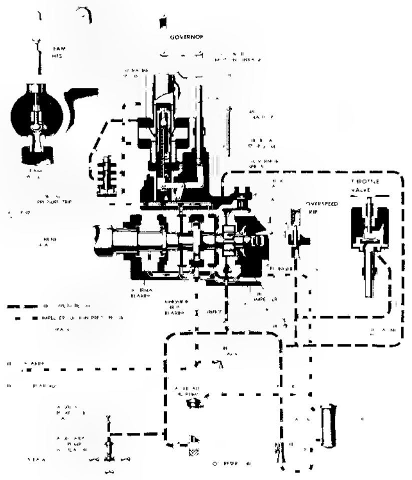


Fig. 13. Diagram of oil and steam lines

28. In Fig. 12 will be seen the speed changer at the base of the governor, and the overspeed trip, which are two of the units mentioned in the paragraph above. Fig. 14 shows the connecting rod of an auxiliary overspeed trip, which should be disconnected. Fig. 17 illustrates the T-Governor and the point at which it should be blocked open. Practically the entire system, including the throttle valve, is shown in cut-away in Fig. 15. Fig. 16 illustrates a typical hydraulic controlled throttle valve of a type which will be found on many large installations, and Fig. 18 is a cut-away of a throttle showing how the unit operates.

29. The figures above listed should be studied in line with the method of turbine destruction outlined in paragraph 27, as each of the units is pictured therein. Fig. 13 is a cut-away section showing the principal oil and steam line connections, and how the governor and throttle mechanism are operated by the oil pressure. Also shown in the cut-away are the four principal bearing points of a steam turbine generator unit.

30. In Fig. 14 is shown another type of steam turbine governor. The speed changer is the small wheel at the upper center of the picture, and the connecting rod of the auxiliary over-speed trip is shown in the center of the photograph. The reset handle of the main overspeed trip is properly indicated.

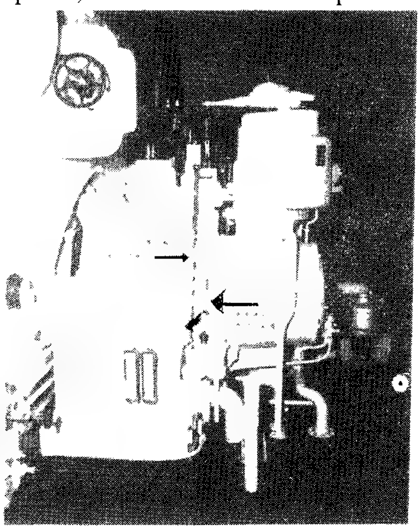


Fig. 14. Governor, overspeed trip, and auxiliary overspeed trip

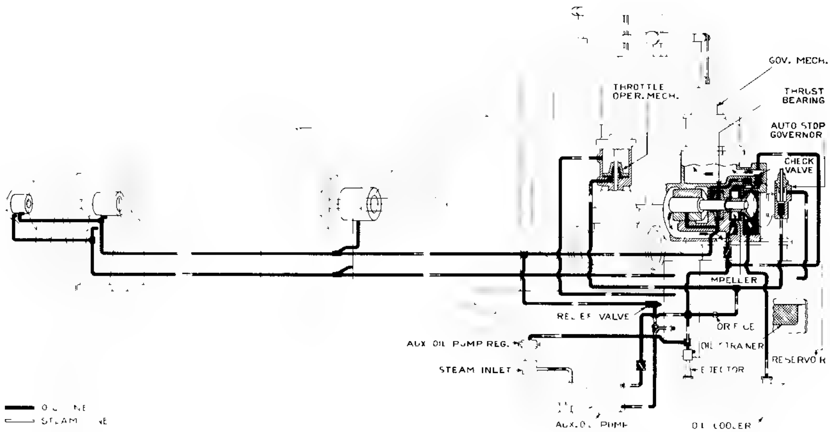


Fig. 15. Diagram showing principal control mechanism

31. The conventional T-type governor is cut-away illustrated in Fig. 17 in larger scale showing the internal action of the speed changer mechanism.

32. The entire governor operation with journal and thrust bearings is illustrated in Fig. 15. This illustration should be studied carefully in order that the relationship of each unit in the governor and throttle valve system is thoroughly understood by those attempting to learn this method of destruction.

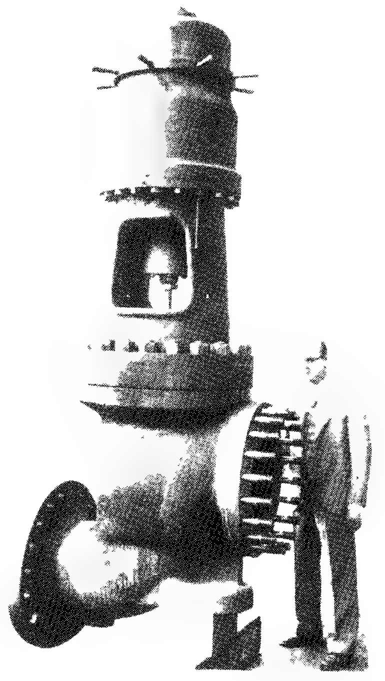


Fig. 16. Throttle valve

33. Fig. 16 is an illustration of an actual throttle valve which controls the transmission of steam from the boiler line to the steam chest. In order to increase the flow, the piston should be raised, and this is normally accomplished by **turning the** handwheel clockwise. However, the correct direction can be determined by the trial and error method. Those engaged in this type of destruction should understand that this valve, on

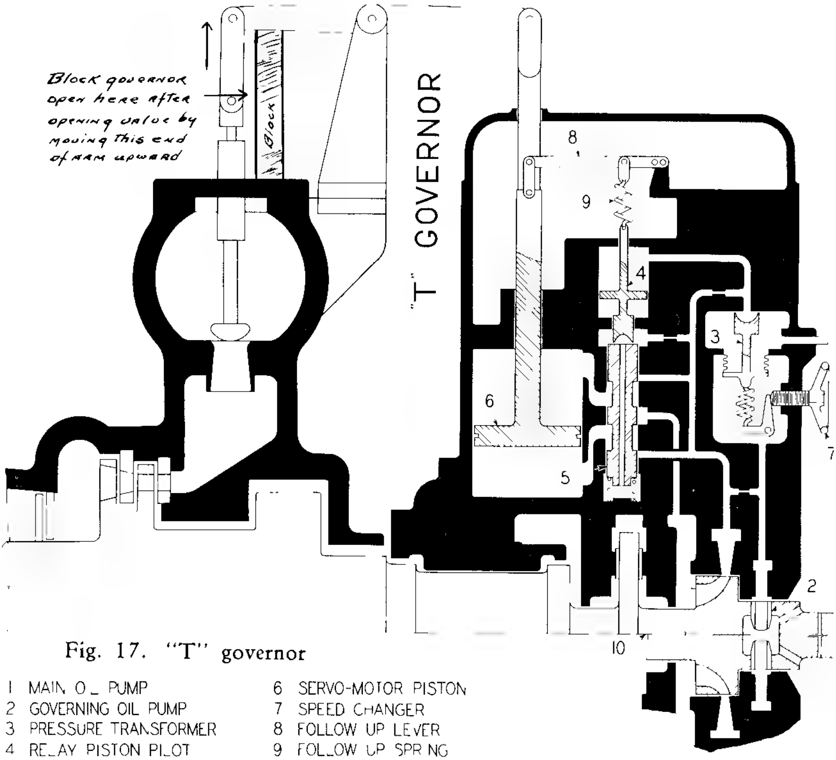


Fig. 17. "T" governor

1 MAIN OIL PUMP
2 GOVERNING OIL PUMP
3 PRESSURE TRANSFORMER
4 RELAY PISTON PILOT
5 SERVO MOTOR RELAY
6 SERVO-MOTOR PISTON
7 SPEED CHANGER
8 FOLLOW UP LEVER
9 FOLLOW UP SPRING
10 TURBINE SHAFT

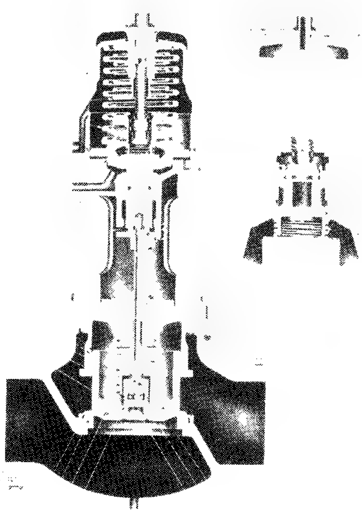


Fig. 18. Throttle valve (cutaway)

the larger units, operates hydraulically and in direct connection with the governor valve. Therefore, unless the governor is definitely secured in an open position, the increase of speed of the rotor more than 10% above the governor setting will hydraulically depress the plunger of the throttle valve, regardless of the setting of the handwheel. Fig. 18 illustrates the internal mechanism of the throttle and how this hydraulic action is accomplished.

34. If the thrust bearing at the head end of the turbine could be destroyed or even slightly damaged, the turbine would be put out of

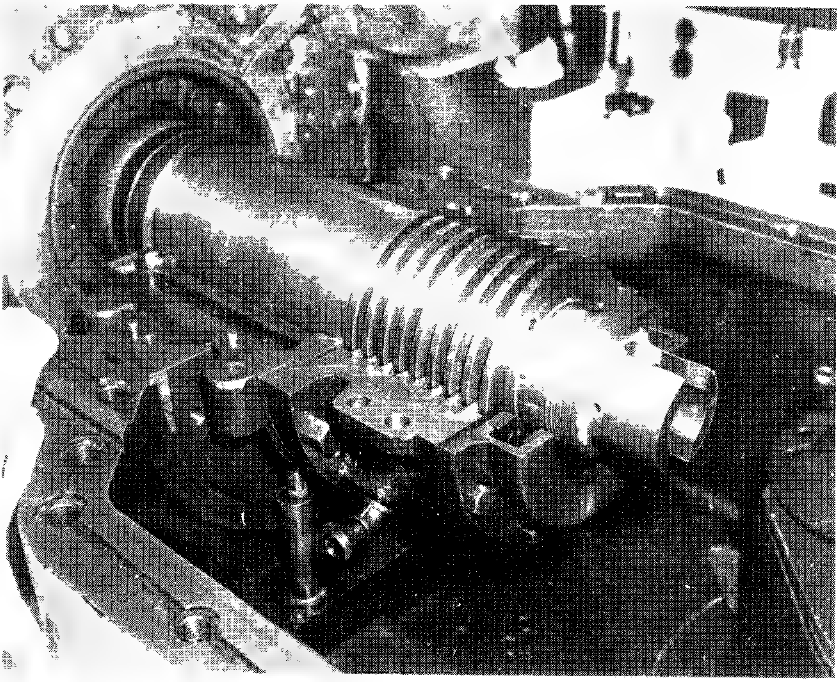


Fig. 19. Thrust bearing with cap and cover removed

action until a new shaft could be constructed, which is an intricate factory operation requiring many months.

35. A typical type of thrust bearing is illustrated in Fig. 19 with the bearing cap and the assembly cover removed. Normally a demolition detail would not have sufficient time to remove this to destroy the bearing area as shown. However, should this thrust bearing be exposed while in the process of turbine repair, steps should by all means be taken to destroy same,

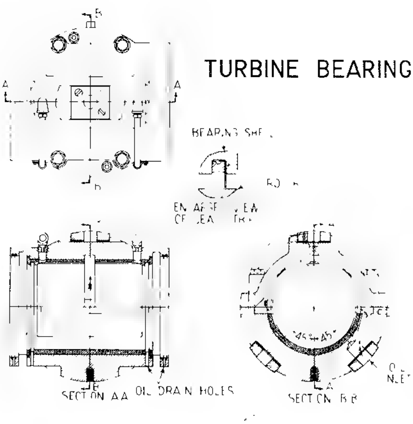


Fig. 20. Turbine bearing

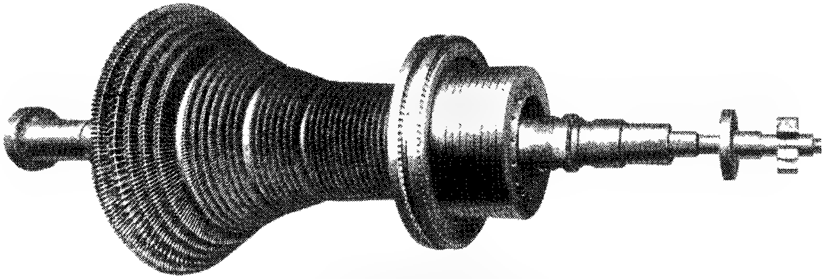
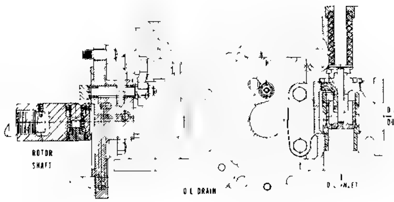


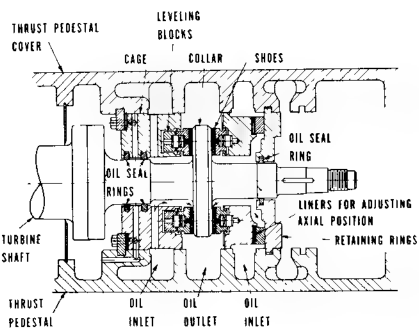
Fig. 20a

preferably with a charge of thermite over the bearing area. The latter spacing is held to such close limits that the slightest displacement in either direction will cause the rotor to sheer its blades against the casing when put into motion.



Overspeed Trip Mechanism

36. Turbine rotor construction is shown in Fig. 20a, which gives an example of the tremendous amount of work involved in the construction of one of these units. The blades upon which the steam acts to turn the rotor shaft have very small clearance between the turbine casing, and if the shaft should be offset a fraction of an inch the accompanying damage would render the assembly inoperative for a period of six months to a year, under the most favorable repair conditions.



Kingsbury Type Thrust Bearing.

37. The details of a turbine bearing are shown in Fig. 20. This is the bearing between the turbine and the generator which is normally exposed sufficiently to permit access even while the turbine is in operation. The cap can be removed while the turbine is in operation, providing the oil supply line leading thereto has been shut both going to and from the bearing. Otherwise, as soon as the oil pressure is relieved by lifting the cap, the turbine will be automatically stopped through the function of the low oil pressure relief

valve operating on the throttle, unless the throttle has been propped in an open position.

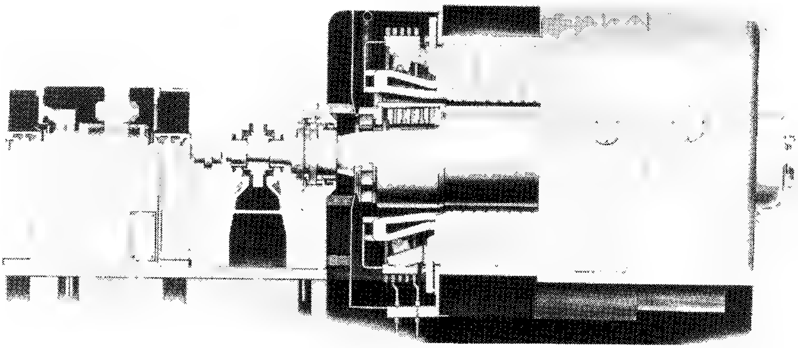


Fig. 21. Generator, exciter and bearing

38. Fig. 21 illustrates a generator and exciter in-line hook-up revealing the cut-away appearance of all the units including the generator's main bearing. It is into the armature and rotor sections of this generator that shots or explosives should be fired in order to short and relieve the load from the generator. The oval and round plates shown in Fig. 21 would normally be the covers over the generator lifting hook, and the inspection plate. The inspection plate or window may ordinarily be opened easily by a thumb screw, though sometimes it is bolted and may be removed only by wrench. This is a safe procedure without personal danger, and will not stop the generator. Where the plate is obviously sealed or a fixed glass window exists, it is probable that the generator is filled with hydrogen as a cooling agent. This, however, offers no danger to the detail effecting the destruction.

39. Steam chest valves, whereby the flow of steam is regulated into the turbine jets, are usually similar in appearance, and the two ordinary types are illustrated in Figs. 22 and 23. In Fig. 22 the valves are ranged along the top of the steam chest in an exposed manner, whereas in Fig. 23 they are contained within the steam compartment and controlled by the rocker arm governor. A study of Fig. 23 indicates the necessity of lifting this valve

Fig. 22. Steam cor .rol valves

assembly to admit steam into the turbine. Destruction effort here would probably only damage parts of minor consequence which could be easily repaired. It may also release a heavy pressure of steam, and would stop the turbine so that its own power would be of no further use in the destructive effort.

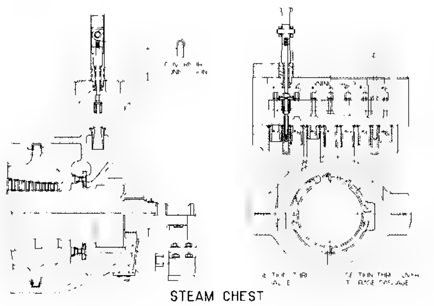


Fig. 23. Steam chest

40. If the lubricating oil tanks of a turbine, or if the piping of the lubricating system, could be breached and the oil therein ignited, a serious fire would develop which would result in sufficient damage to probably require the entire rebuilding of the turbine. In various figures herein the many oil lines are visible, indicating the ease with which these could be destroyed. On some turbines the oil tank is located near or on the turbine itself, and a small explosive charge would breach same for ignition. The temperature of the oil in these lines varies from 110 to 160 degrees, and while not normally combustible, can at this temperature be ignited with thermite or phosphorous. It is again pointed out that the slightest breach of any of these oil lines would immediately shut the throttle valve and stop the turbine. Therefore, no action of this nature should be taken if the power of the turbine is desired for any purpose.

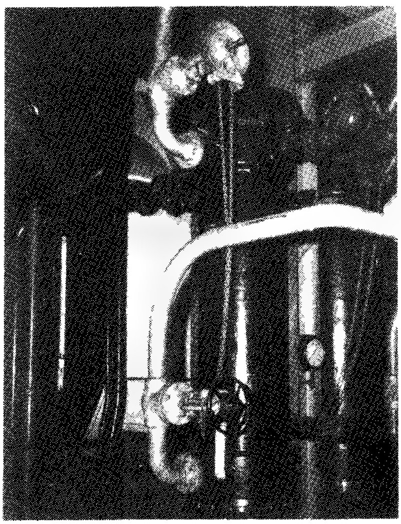


Fig. 24. Lubricating oil coolers

41. By wrecking the oil cooler shown in Fig. 24 the source of cooled and supply oil would be cut off, and if the turbine were allowed to continue in operation, all bearing surfaces within the turbine and generator would soon freeze through the lack of lubricant, and probably ruin both rotors and bearings. Oil coolers are usually found in duplicate for each turbine, and both should be destroyed, as they are usually piped so that each operates independently of the other in the event of the failure of one.

42. Most modern turbo-electric installations contain the exciter in line with the generator but many of the older and Oriental installations may have this exciter as a separate unit such as is shown in Fig. 25. This unit is very important to the generator as it supplies the magnetic field therein, and should be destroyed. However, the average plant may have one or more spares which can be connected within a short space of time, so this step is considered inadvisable unless total destruction is desired.

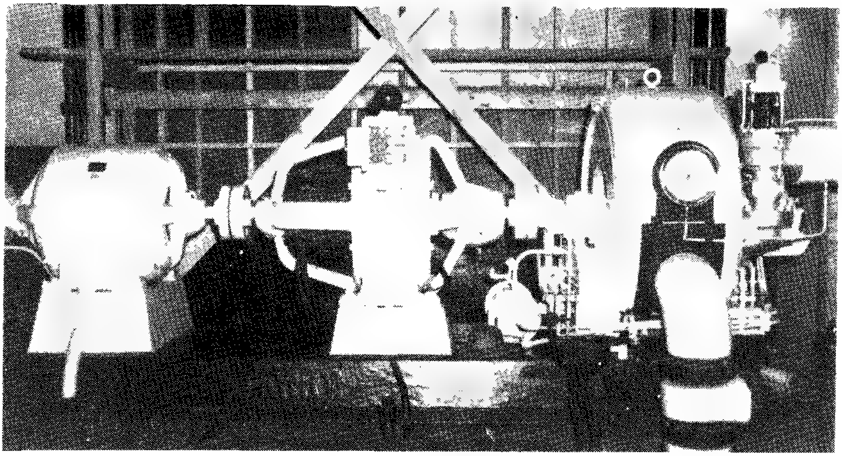


Fig. 25. Separate exciter

43. Every large power plant contains one or more huge overhead cranes similar to the one shown in Fig. 3, for the purpose of moving heavy equipment. The principal one will be located in the turbine room and usually moves on a track across the entire room area. This crane is absolutely necessary to the repair of any major unit in the plant and should be destroyed.

44. Elsewhere in this manual is described the method by which these overhead cranes could be dislodged or knocked off their track. This process should be completed here with an attempt being made to drop one end of the crane onto the generating equipment below. These cranes are easily run and within the control cab will usually be found three rheostats, one controlling the movement of the crane on the track, and the other two operating the vertical and side motion of the lifting element.

45. In every large steam turbine generator plant will be found one or more condensing units, usually located directly under the turbines they serve on the floor below. Sometimes one condenser may be used to condense the steam of two or more turbines. These condensers act as heat exchangers by forcing cool water through a boiler-like installation, similar to the one

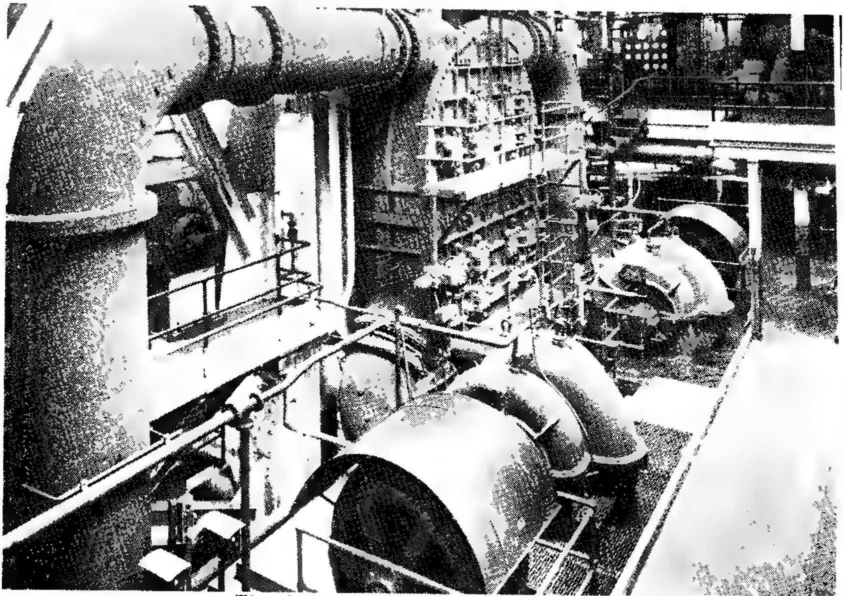


Fig. 26. Large condenser installation

shown in Fig. 26, and by circulating it through pipes therein condense the steam as it issues from the turbine above. The unit serves two purposes, first, creating a necessary vacuum on the outlet side of the turbine, and second, conserving water through the condensing of steam and re-use thereof.

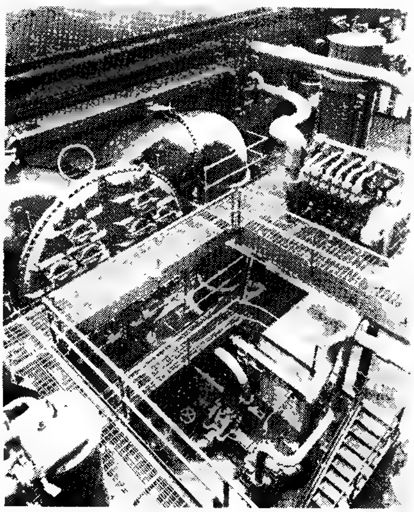


Fig. 27. Radial flow condenser

46. In a large condenser installation a great volume of cooling water is required for efficient operation. This is usually obtained by locating the plant near a large body of water (which may be salt) or through large capacity deep wells; or as is sometimes the case, water is taken from the municipal system.

47. Very little time is required to put a condenser out of operation, and a sufficiently large amount of damage and delay can be accomplished to justify the effort wherever time permits. Most condensers have a number of inspection doors on the face thereof, as will be seen on each of the condenser installations

illustrated herein, and these doors may be opened to permit an explosive charge being placed on the inside walls. If the condenser is in operation, however, the effort should be directed at the outside of the unit, and the place of attack would be at the junction of the shell and either the inlet or the outlet pipe. In Fig. 28 the entire piping arrangement can be seen with the cooled water entering the condenser through the two pipes on the bottom, and the two discharge pipes at the top. These particular castings are intricate in design and specially made, and to replace would require construction at the condenser factory, and probably complete removal of the condenser to replace the shell. A small charge of TNT would effectively do the job.

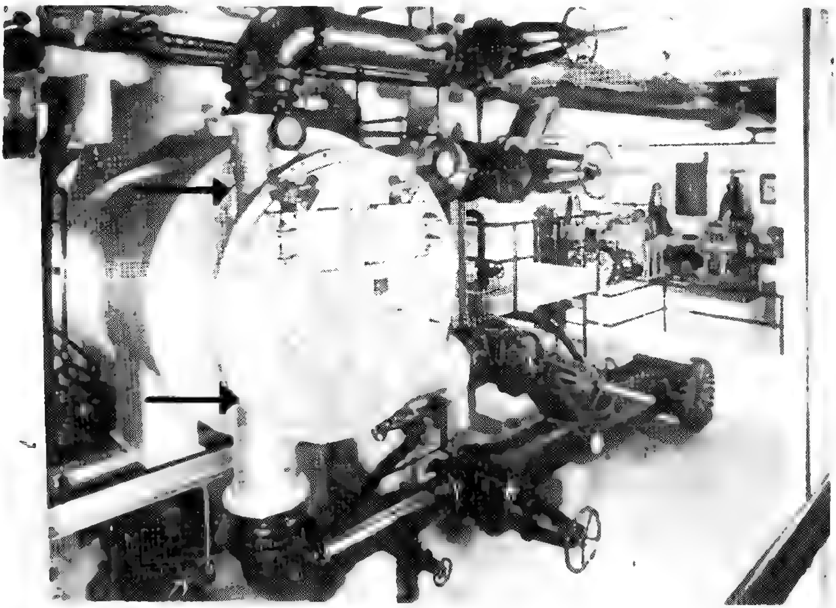


Fig. 28. Condenser with pumps on gallery

48. If the shell is steel, it could probably be welded in place, unless a rather large section were knocked out. If it were cast iron, as is very often the case, it would probably require replacement. A study of the appearance of the condenser housing and pipe arrangements of Figs. 26 and 27 will indicate that the first is cast iron and the second, obviously forged or cast steel, at the junction of pipe and condenser.

49. The thickness of the housing of most large condensers is so great that considerable thermite would be required to burn through. If a sufficient supply is available, however, it should be used and would be most effective if placed within the circled area at the top of the condenser unit shown in Fig. 27.

50. The pumps which control the flow of cooled water through a condenser are especially vulnerable and easily destroyed. Fig. 29 is a closeup of an electrically-driven centrifugal pump which could be destroyed by placing an explosive charge on a critical portion of the housing, such as indicated, or by igniting thermite at the bearing surfaces. The oil pipe lines as shown in Fig. 29 could be knocked loose and the pump allowed to continue in operation, as within a few minutes all bearings would freeze from lack of lubricating oil, with almost irreparable damage to shafts and bearings.

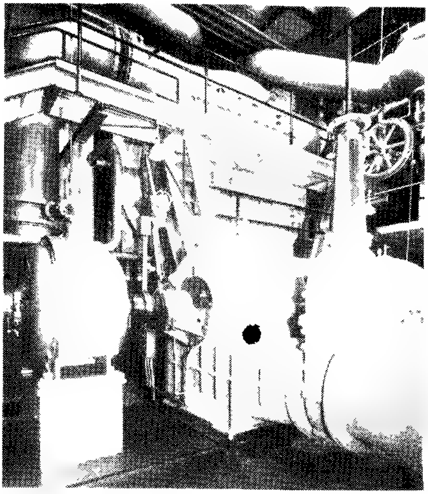


Fig. 29. Condenser circulating pump

51. The circulating pumps usually operate on the cold intake water line and if the condenser room is below the outside ground level, the whole could be effectively flooded by breaching the pipe line between the pump and the boiler.

52. In Fig. 28 the circulating pumps are installed on a gallery at the side of the condenser, and in some installations the pumps may be found in a separate room. Also in Fig. 28 some study should be made of the piping and housing arrangement to determine the point at which explosives should be placed to do the greatest amount of damage. Obviously here they would be placed either at the top or bottom, between the pipe and the inside of the condenser housing as illustrated by the arrows. Here a charge would breach not only the special forged housing pipe connection but also the main condenser housing behind.

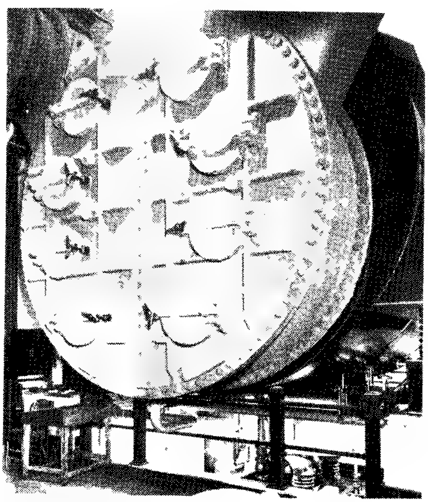


Fig. 30. Condenser face showing inspection doors

53. In the work of destruction of any type of mechanical equipment, condensers, turbines or others, it will be rather difficult to find installations exactly alike. Therefore,

it becomes necessary for those being trained in this work, to become so familiar with the problems and methods of destruction that they can immediately, upon viewing any unit, recognize the point at which explosives or incendiaries should be placed to do the greatest amount of damage.

54. Fig. 30 illustrates the inspection doors on the face of a large condenser, and visible underneath is a unit known as the hot-well, which collects the condensate and circulates it back to the boilers. Fig. 31 is a close-up of this arrangement which can be found under every condenser and is a unit which can be, as is evident from the illustrations, quickly destroyed with small explosive charges. No hand action should be employed in this area as the water contained in the pipes and well is above scalding temperature.

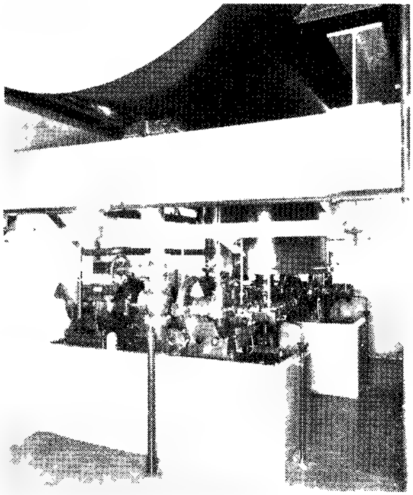


Fig. 31. Hotwell under condenser

55. As has been mentioned before some plants secure a portion or all of their water from deep wells, if sufficient sub-surface water is available, or maintain a standby battery of these pumps for use in an emergency. Fig. 32 illustrates a typical type which should be destroyed whether in use or not, by the method shown elsewhere in this manual.

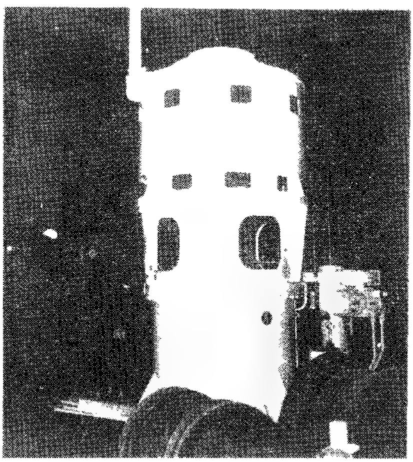


Fig 32. Centrifugal pump

56. While the boilers supply the steam for turbine operation, and therefore would appear to be so essential as to justify destruction, it is seldom that this step should be taken. The boilers would all have to be destroyed, as the average plant is so constructed that by increasing the boiler production to full capacity a few could carry the load of the entire plant. Boilers are difficult to destroy due to the size and nature of their construction, as large scale destruction is impossible and minor damage can usually be quickly repaired. However, should the turbine room destruction be com-

pleted and sufficient time remain it would be well to put the boilers out of operation. This may be done by the following method:

(a) Make certain the steam-output valve (Fig. 33) is fully open.

(b) Screw down or block all of the safety valves of that particular boiler, shown in Fig. 34.

(c) Increase the rate of fuel supply by opening the feed nozzles wider in the case of oil; or increasing the stoker speed where coal is used.

(d) Shut the steam output valve (Fig. 33).

(e) Get clear of the building.

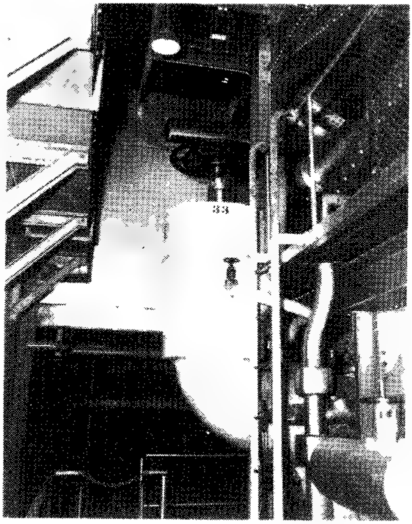


Fig. 33. Steam output valve

As has been pointed out, it is considered that demolition efforts in the boiler room of a power station are less beneficial than in other sections of a plant. However, there will be other missions of sabotage details where boiler destruction or damage would be extremely important and it is covered in this chapter in order that the proper methods may be understood. Bursting pressures will be developed rather quickly and when the boiler explodes it will destroy itself and damage a substantial amount of surrounding equipment.

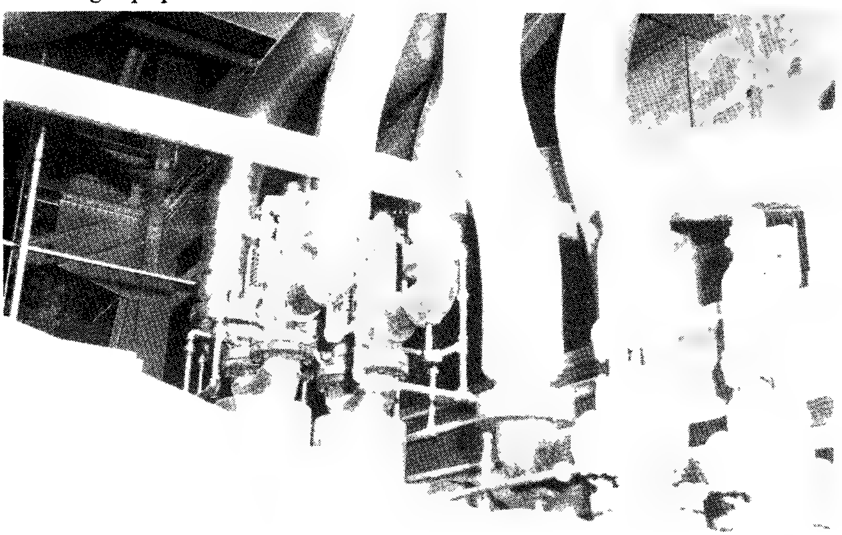


Fig. 34. Boiler safety valves

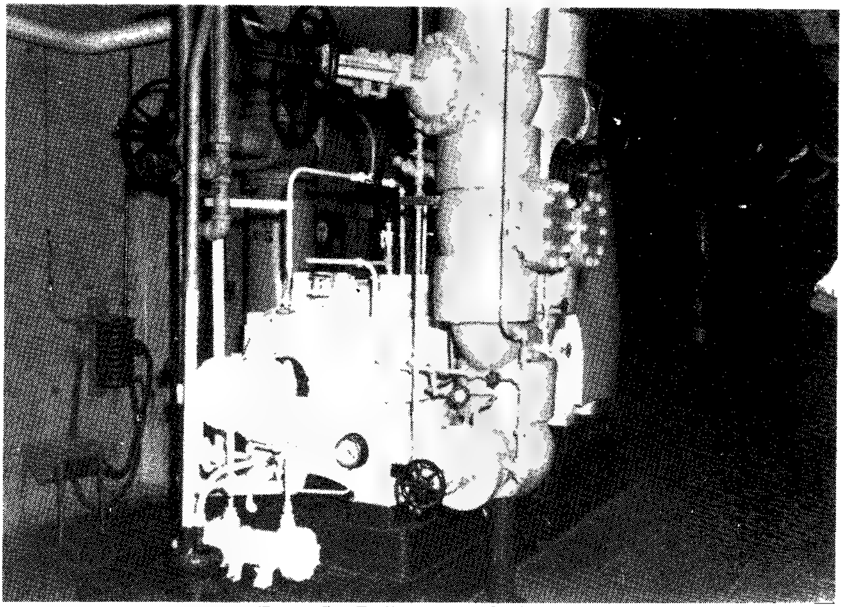


Fig. 35. Boiler water feed pump

57. Another and probably more effective way to ruin a boiler installation would be to wreck the water feed pump (Fig. 35) which supplies that particular boiler: or merely shut off the motor and close the two valves. Without water the boilers will quickly run dry and the intense heat will melt the tubes to such an extent that it would require a month or more to put the boiler back in operation.

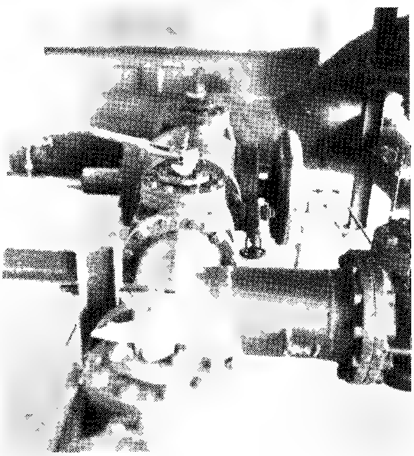


Fig. 36. Fuel gas control valve

58. The fuel supply lines or pumps could be breached, and the released flow of gas or oil ignited. which would do considerable damage. Most modern plants are constructed so that two fuel supplies are available. Fig. 38 shows a typical boiler installation equipped to employ either fuel oil or fuel gas. The fuel oil is supplied by pumps similar to that shown in Fig. 37 but the gas is supplied

under main pressure, and a typical control valve is shown in Fig. 36.

59. Many plants use coal for fuel and here it would be advisable to destroy the conveyor system on the outside of the building, which brings the coal into a common hopper used by all boilers. Fig. 1 of this chapter shows a typical outside coal conveyor system with the inclined endless track and track power house.

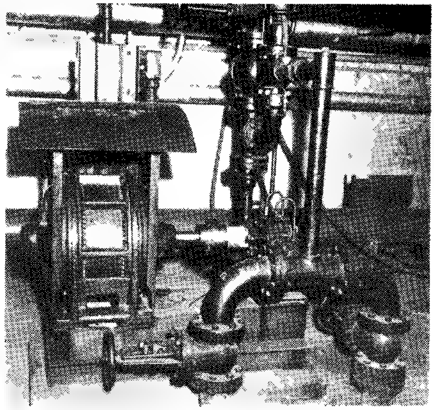


Fig. 37. Fuel oil pump

60. Considerable damage could be done in the control room but unless substantial time is available this is not recommended. In Figs. 39, 40 and 41 will be seen typical control panels. Fig. 39 probably represents the type more commonly used in Oriental countries, while Figs. 40 and 41 show a more modern type of control and switch gear. The room containing these panels will usually be located in a smaller separate building adjoining the turbine room, on the opposite side from the boiler building, or on a balcony in the turbine room, or on the same level as the turbines.

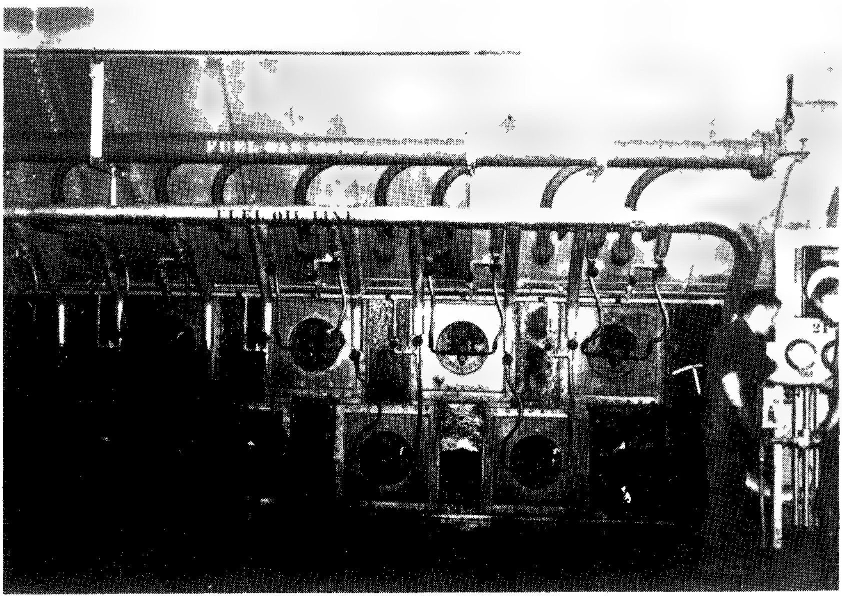


Fig. 38. Boiler fire-box showing gas and oil fuel lines

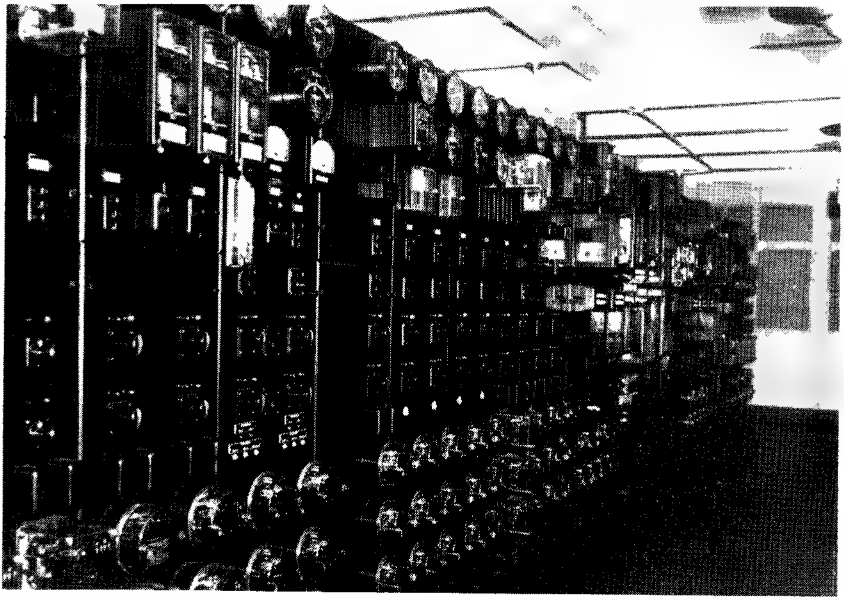


Fig. 39. Control panels

61. The higher plant voltages are substantially reduced in these panels so that they may be more easily controlled with smaller wire. However, this usually exceeds the normal domestic voltages, and therefore great care must be exercised in any damaging effort in this area.

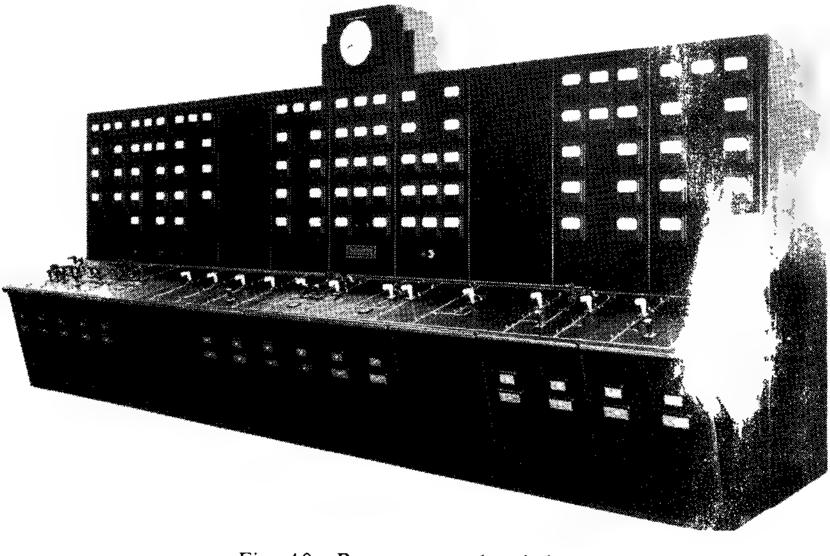


Fig. 40. Remote control switchgear

Fig. 41. Modern switchgear control desk

62. Should the plan contemplate the destruction of the control panels, the detail should destroy both the back and the face of a system as shown in Fig. 39, but only the back of those shown in Figs. 40 and 41.

Fig. 42 Metal enclosed switchgear

63. Those engaging in destruction work are again warned that the average modern power plant contains a great many safety devices, which become operative when certain critical elements of the plant cease to function. Therefore, any destructive effort in the control or switch gear rooms would immediately shut off the turbines, thereby eliminating their power for other steps of plant destruction. In this same connection it is well to always remember that efforts to destroy or sabotage a power plant, if directed toward elements not covered herein, or to wiring or minor installations that may appear easier to destroy, will invariably possess great inherent danger to the destruction detail without accomplishing the larger measure of damage otherwise possible.

64. Fig. 42 shows a very modern type of enclosed switch gear in which all of the elements are contained in locked cabinets. These are actuated remotely from a control panel probably located in an adjacent room or building. Installations of this type will probably not be found in Oriental countries but if they are they should be destroyed with the same care and caution as has been stressed before, and only after the other and more important features of destruction have been completed.

Fig. 43. Transformer and switchyard

65. The transformer and switch yard is usually located immediately adjacent to the plant, and probably on the switch gear and control room side as shown in Fig. 43. The transformers of a large station are specially built units and are of course absolutely necessary in the scheme of power distribution.

66. Fig. 43 shows a typical yard installation showing the batteries of large transformers on the right, which are probably used to step up the plant developed voltages many times. In the middle and on the left will be seen the oil switches and circuit breakers which automatically disconnect an entire circuit, in approximately one-twentieth of a second, upon the failure or over-load of that circuit.

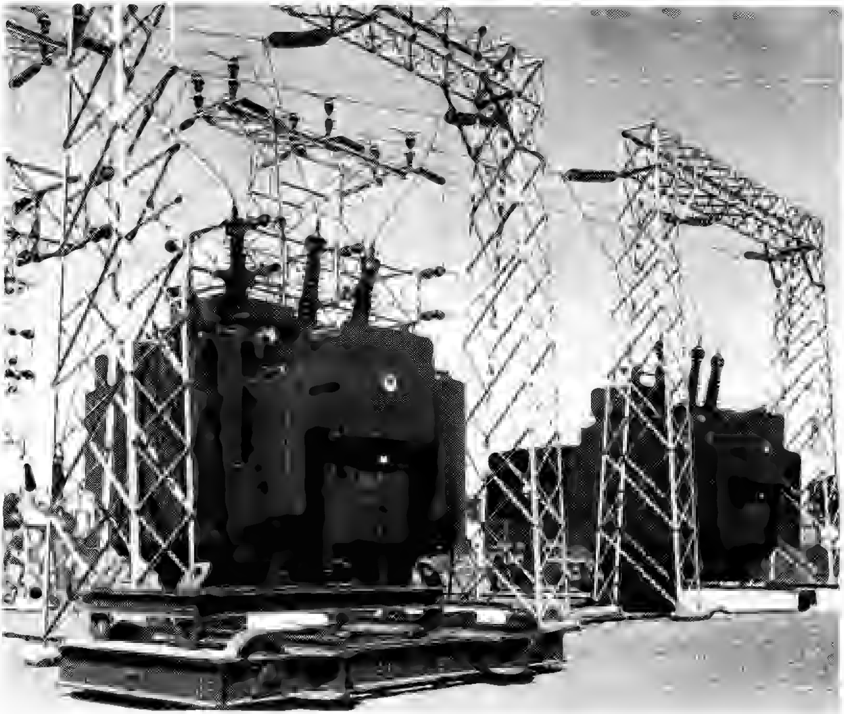


Fig. 44. 102 ton Westinghouse transformers

67. Both the transformers and the circuit breakers are oil immersed units and the more modern installations use an oil that is non-inflammable and which probably could not be fired by ordinary means. The transformers utilize this oil as a means of cooling the interior, in which high temperatures would otherwise be developed by the electrical transforming action. In circuit breakers the oil is employed to extinguish the arc caused upon the breaking of a high voltage circuit.

68. In Fig. 44 are shown two extremely large transformers with the truck used to place and remove them, and in the background will be seen a typical circuit breaker.

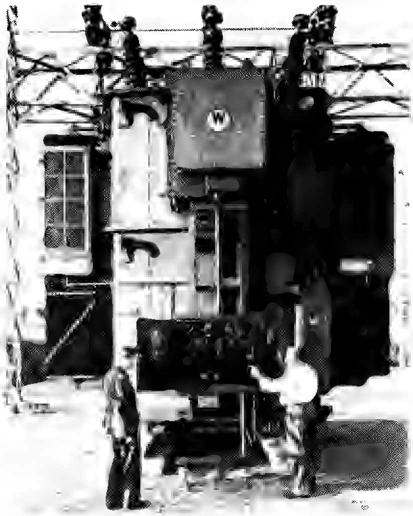


Fig. 45. Automatic tap-changer mechanism

69. Large transformers are invariably built on wheels and installed on tracks. If a destruction detail had no other suitable tools, explosives or weapons, to destroy one of these units, an effective temporary job could probably be done with a pinch bar by pinching the unit off the end of the track shown in Fig. 45. Due to the extremely high voltages contained in the average large transformer, great care must be exercised while operating around them, and in the method just mentioned, steps would have to be taken to get clear of the overhead steel and wiring section before the toppling of the transformer.

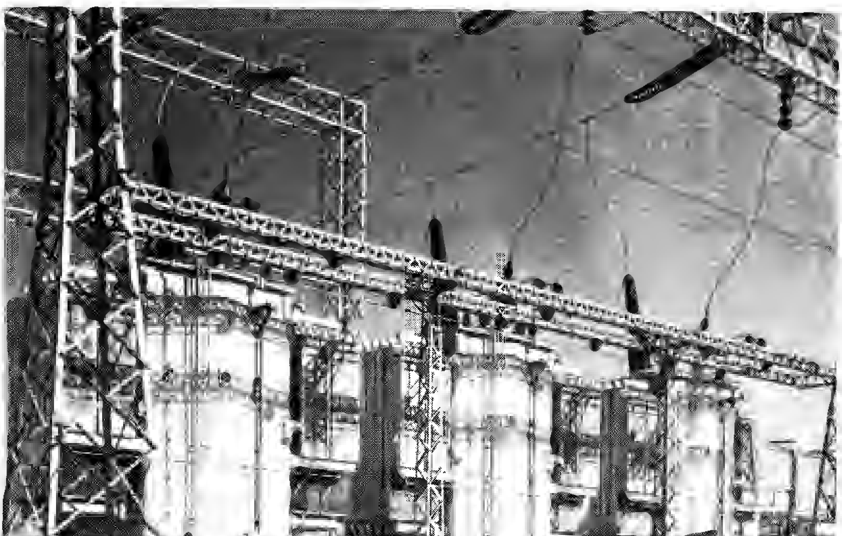


Fig. 46. Step-up transformers at primary plant

Some realization of the size and capacity of the transformers shown in Fig. 41 can be gained from the knowledge that these weigh 102 tons apiece, stand 21 feet high, and step up the current from 12,000 to 115,000 volts on the output side.

70. The insulators at the top of the transformers are especially vulnerable to rifle fire but such destruction should be resorted to only for its nuisance and temporary delay value.

71. Fig. 15 illustrates a large transformer with the door to the tap changing equipment open. By this system the capacity of the transformer is automatically changed, dependent upon the line requirements. If time permits this machine should be demolished by a small explosive charge.

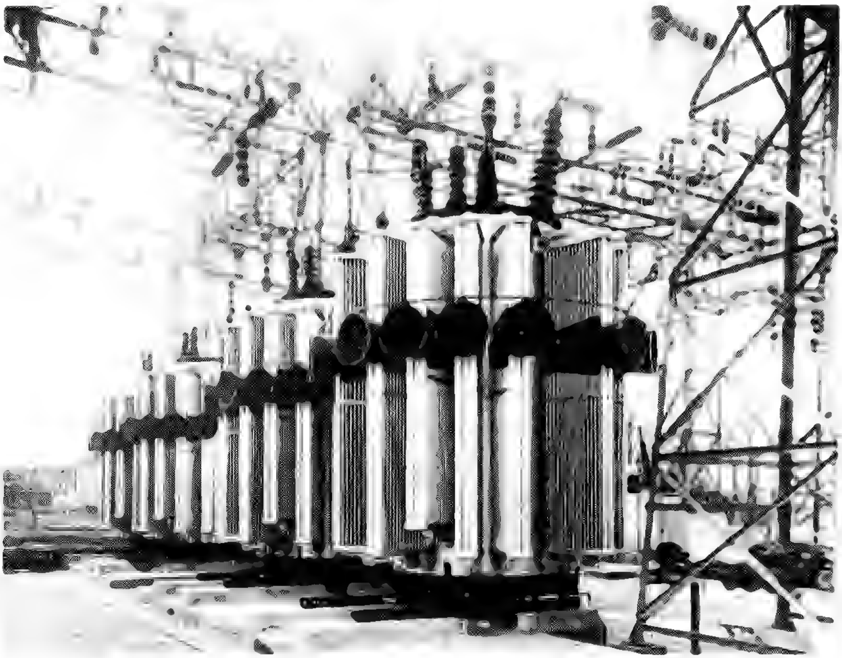


Fig. 47. Transformers with oil-cooling radiators

72. Probably the best way to destroy one of these large transformers is to detonate an explosive charge against the bottom of the tank. If a sufficient amount is used it will not only breach the casing but will rupture the internal winding necessitating complete rebuilding. Nuisance damage could be effected by firing small calibre ammunition through the radiator type oil cooling device, which if done, should be near the bottom of the fins in order to spill as much of the cooling oil as possible. If this were done and the transforming action continued for a few hours the transformer would generate sufficient internal heat to ruin the entire unit.

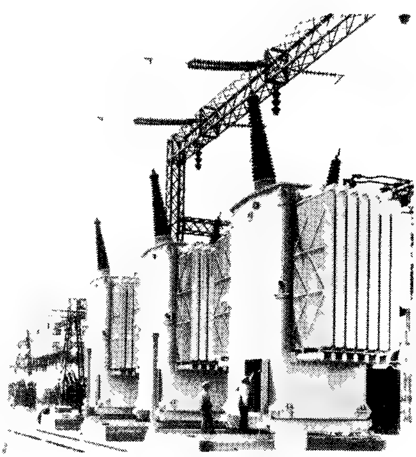


Fig. 48. Primary voltage of 13,000 is stepped up to over 150,000 volts here

73. Figs 46, 47 and 48 illustrate additional types of large capacity transformers. All of these are mounted on solid concrete bases and could be very easily destroyed by an explosive charge placed as indicated above. Usually in each transformer station will be found one or more spare transformers ready to be cut into the line if necessary. These, of course, should always be destroyed as well as those in actual operation.

74. Also in each large transformer yard will be found a very heavy capacity crane similar to the one shown in Fig. 71. This is used for the purpose of lifting or otherwise moving the transformers and should be destroyed. Reference to Fig. 71 will also show a spare, covered transformer on the small railroad track, ready to replace one of the three shown in the enclosure, if necessary.

75. It should be again impressed upon all personnel, training for, or engaging in, all forms of power destruction that they should stay clear of all electrical connections. These very often carry fatal voltages and usually represent the least desirable element to destroy.

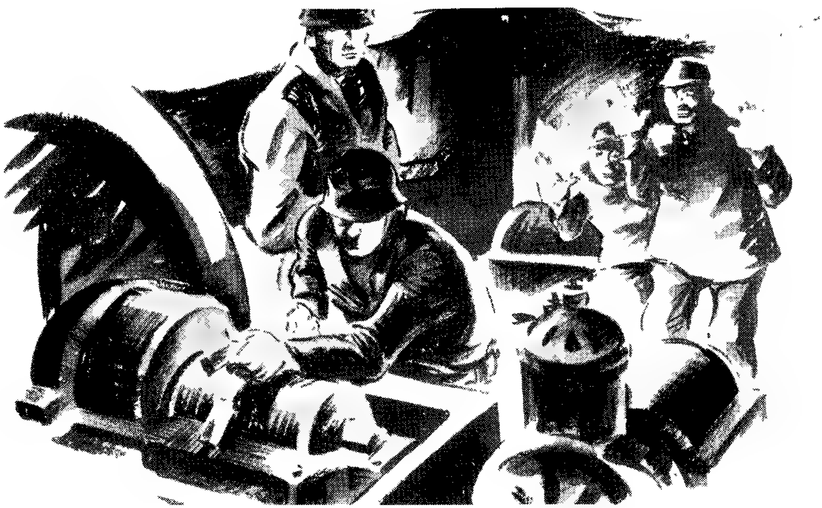


Fig. (d) The thrust bearing is the most vulnerable part of a steam turbine

HYDRO-ELECTRIC POWER

76. Hydro-power is developed through the pressure of falling water, and therefore plants will usually be located on or near a body of water where some elevation is natural or artifically established. There are two general types: first, where the powerhouse is built into and is an integral part of a dam; and second, where it is constructed at the end of a penstock issuing from a pipe line or diversion canal.

77. Hydro-electric plants are in very general use in Oriental countries and in most sections produce the large majority of developed power. As is the case with steam electric installations, hydro-electric plants will differ to a very minor degree throughout the world.

78. In view of the fact that these plants are generally located on a substantial water supply, they are often constructed in remote areas somewhat apart from congestion and adequate defensive measures. Therefore, to the surface detail they present a target which can be more easily reached and

Fig. (e) A large hydro-electric plant in Japan

Fig. 49. Hydro-electric powerhouse and penstock

destroyed than most others. They are very easily distinguished from the air and are also especially vulnerable to destruction by aerial bombing.

Fig. 50. Penstock, anchor, separators, and valves

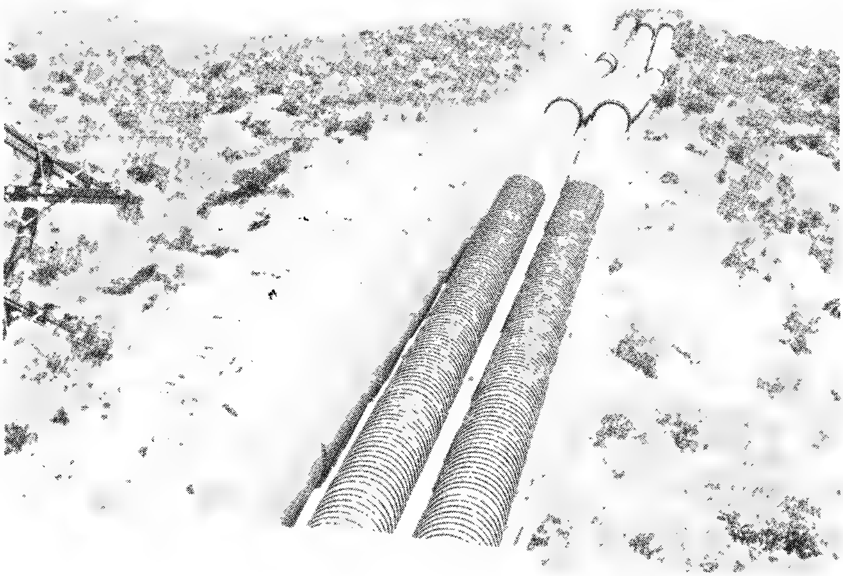


Fig. 51. Penstock pipes

79. Fig. 49 illustrates a typical hydro-installation showing the powerhouse in the foreground and the three penstock pipes coming down from the top of the hill. The detail of the penstocks on the hill and at the base is shown in Figs. 50 and 51. These pipes, especially in the lower sections, carry tremendous pressures and are very heavily built, sometimes being constructed of steel as much as three inches thick at the point of entering the turbine room. A system of valves is used on these penstocks to prevent bursting or collapsing from the terrific water pressures and vacuums that are quickly created from the sudden stopping or acceleration of the water flow.

Fig. 52. Penstock control valve

80. From twenty to thirty minutes, and on larger units perhaps more time, is required to start the flow of water from the surge tank at the top of the hill through the nozzle and turbine wheel and have the latter turning at generating speed. This procedure is accurately timed and maintained in

order to prevent the penstock from bursting from water pressure before safe turbine RPM's are attained.

81. Even more time is required to stop a turbine unit in operation, in order to prevent the penstock from collapsing through the vacuum created by shutting off the water supply at the surge tank. Air in large volume must be introduced as the water is turned off to overcome the tremendous vacuum otherwise created.

82. A surface detail could easily burst the penstock, which would produce a tremendous amount of destruction, by closing the lower control gate at the head of the turbine after blocking or wiring shut the automatic valves located on the lower part of the penstock. The penstock would burst at some low point and the resulting surge of water would practically wash the powerhouse away. The control valve at the surge tank would have to be blocked open as this normally automatically shuts and admits air in the event of failure of some functioning at the turbine end.

83. The penstock could be collapsed if the large intermediate valves between the surge tank and the powerhouse were closed suddenly. The upper portion would burst from pressure and the penstock below the valve would collapse from vacuum. The air inlet valves located on the penstock at this point, which serve as an automatic volume control in the case of a failure of the water supply, should be wired or blocked shut before turning off the valves.

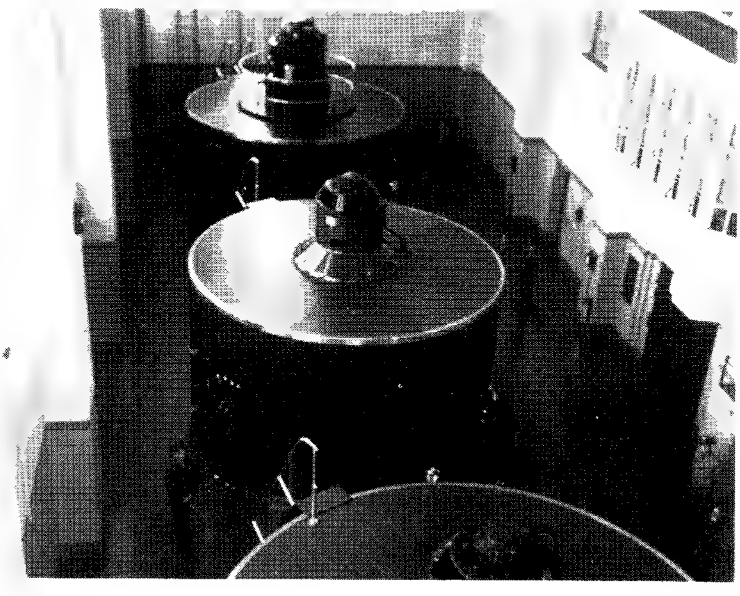


Fig. 53. Hydro-electric generators

84. As the water enters the powerhouse, it proceeds through a subterranean tunnel, usually cast in concrete as a part of the base of the power plant itself, and into a series of nozzles which direct the force of the water against water wheels or turbines mounted on a vertical shaft. The water continues on out, discharges into a race below the turbine room and powerhouse.

85. The generator and exciter are usually located on the upper end of the vertical shaft in what is known as the generator room, as shown in Figs. 53 and 54.

Fig. 54. Generators and overhead crane

86. The shaft connecting the turbine wheel with the generator is usually a very heavily constructed and an accurately machined unit which is subject to easy damage by thermite. It is very accessible on a sub-floor below the generator as shown in Fig. 55. The mechanism just below the feet of the Marine in the picture is a ring of gates which control the volume of water being admitted, to the turbine directly underneath, from the nozzles. This control is operated by handwheels located in the generator room either near the generator or in a control room like the one shown on the right of Fig. 53.

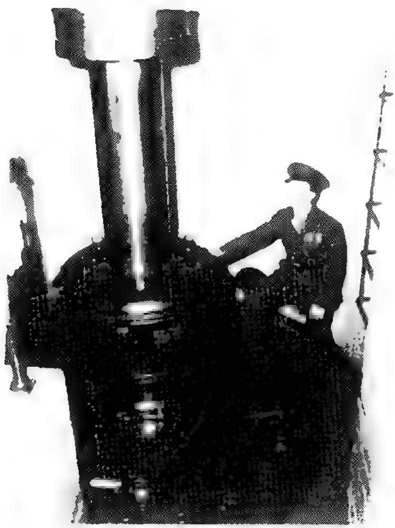


Fig. 55. Main turbine shaft and speed control gates

87. The entire wheel and shaft assembly could be practically destroyed by igniting a substantial charge of thermite against the shaft at the point where it emerges from the central bearing, or by detonating a substantial charge of TNT tightly packed between the control arms shown at the bottom of Fig. 55.

88. The value of blasting the overhead cranes, shown in Figs. 54 and 60, onto the turbines below cannot be over-emphasized.

89. The exciter end of the generator shaft is shown in the top center of Fig. 56 and at this point a tremendous amount of damage could be done by damaging the principal bearing which will be contained inside the housing at the upper platform level. The generators can be shorted by exploding a substantial charge of

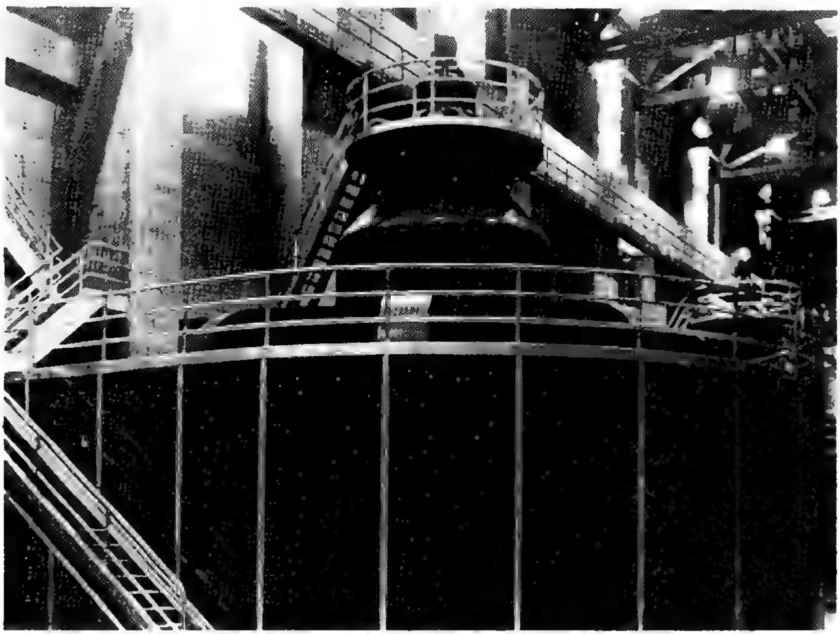


Fig. 56. Generators showing exciters

TNT in the interior of the housing. Inspection windows and sometimes doors are usually located on the upper side, as shown in Fig. 60, which may be safely broken for the insertion of weapons or explosives into the generator compartment. The mere detonation of a TNT charge in this area would put the generator out of operation for a period of several months. Fig. 60 furnishes an idea of how quickly this could be accomplished on the four turbines in this plant.

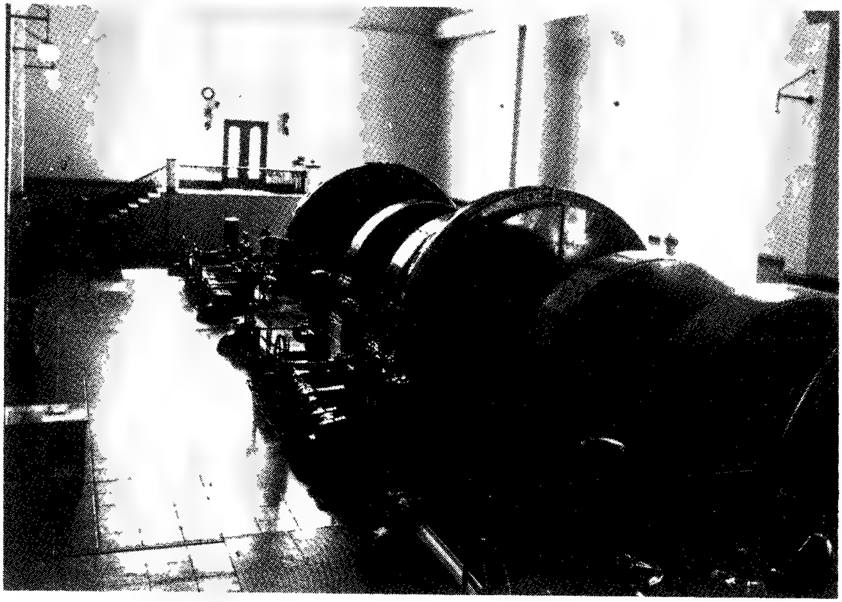


Fig. 57. Horizontal generators

90. An older type of turbine employing a horizontal drive, as opposed to the more modern vertical type, is shown in Figs. 57, 58 and 59. The detail of the control and governor mechanism of one unit is clearly visible in Fig. 58, which shows the gear case on the right and the generator on the left. Fig. 59 shows the detail of the generator shaft and bearing, at which point destructive action should be taken.

91. The units which have been described in the previous paragraphs of this chapter employ the penstock and surge tank method. The water of these units may have been carried by pipe line or open canal to the surge tank at the top of the hill from a source many miles away.

92. In the units illustrated in Figs. 61, 62 and 63 the powerhouse is contained within the dam itself and secures its operating pressure from less elevation but a greater volume head of water.

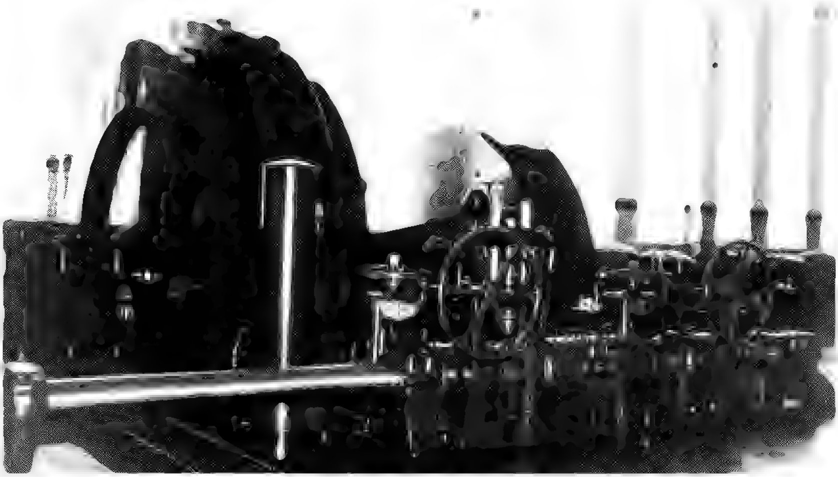


Fig. 58. Generator and control devices

93. Fig. 61 is a single turbine constructed within the dam, and while apparently small employs a 4000 KV-A, 12,500 volt generator. This type may be found on small rivers where the drop is relatively low, though usually it will be contained in a turbine generator building.

Fig. 59. Horizontal generator main bearing

Fig. 60. Modern turbo-generator installation

94. Figs. 62 and 63 show modern type installations built in gravity-type concrete dams. The internal functions of plants constructed in this manner are the same as the high exposed penstock types discussed in this chapter, except that the pressure and vacuum methods of penstock destruction are not as effective in this type.

Fig. 61. Concrete-filled type dam with built-in generator

Fig. 62. Gravity type dam with built-in powerhouse

95. The methods of destroying the turbines, generators, and shafts are the same, as the construction from the water nozzles to the generators is generally the same in all hydraulic types.

Fig. 63. Gravity type dam with powerhouse

96. The long, low bridge-like structure in the upper right of Fig. 63 is the outer trash rack to prevent floating debris of all types from entering the area immediately in the front of the penstock openings. In addition to this outer rack, each penstock is provided with a trash screen to prevent

any large solid object from entering the turbine wheel. These screens are removable for cleaning and a very effective job of demolition could be accomplished by opening the screen aperture slightly and dropping a substantial charge of TNT into the intake, timed to explode when it reaches the lower penstock or turbine area. Any such explosive charge must be securely tied and the fuse well-taped therein to avoid being torn loose through the force of the water.

97. This same method can be employed at the intake system of most hydraulic power plants except that on the intake at a diversion dam the charge should be timed to explode at the approximate point where the intake or forebay issues from the diversion dam.

98. The large, outside crane shown in Fig. 63 should be destroyed or toppled over into the water in front of the intake area. Hydraulic jacks of large capacity, one or more of which will be found in a power house, would prove ideal for this purpose.

DIESEL POWER

99. As has been stated elsewhere Diesel power until recently has been used largely as a standby source in the event of failure of the primary system. It is also used by industries for regular service where the power requirement is not relatively high. More recently its use has been growing as a source of primary power even in metropolitan areas.

Fig. 64. Diesel-electric generator house

100. Fig. 64 shows a typical modern installation in which the exhausts are run into a concealed exhausting room, and therefore, are not visible. The high tension wires leading from this station are underground, and as a result it becomes difficult to identify this as a power station.

101. The engine and generator equipment as it is installed inside of the building shown in Fig. 64, is pictured in Fig. 65. This shows three large generator units with a portion of the control panel on the left margin. These units may be easily destroyed with explosives detonated between the cylinder blocks, or through the use of thermite on the upper crank case

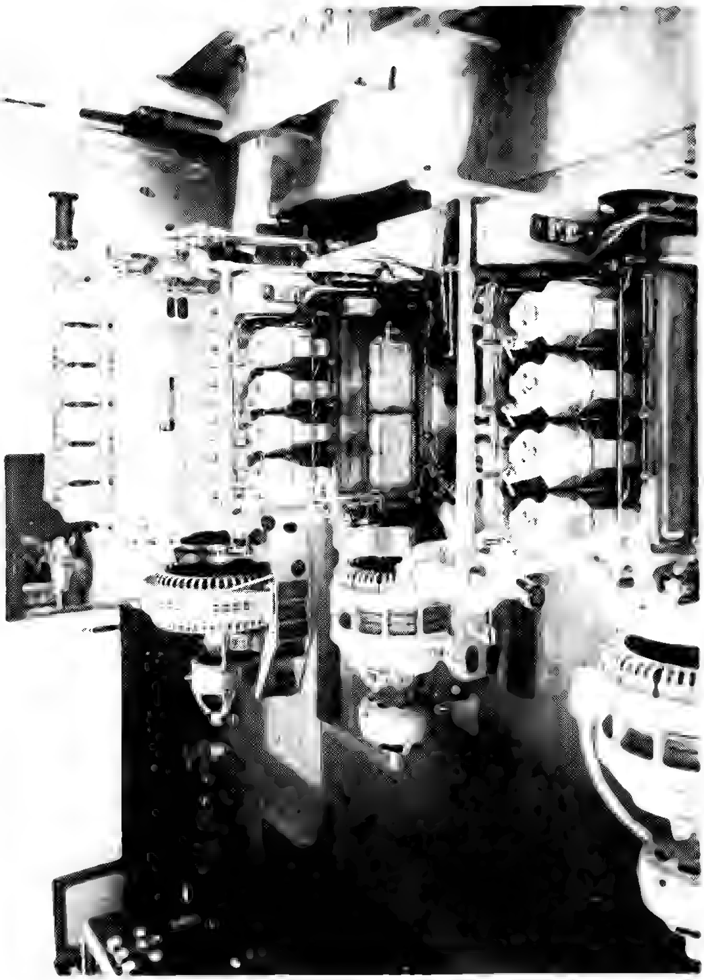


Fig. 65. Diesel engines and generators

housing. The fuel metering pump shown on the left of each line of cylinders should be destroyed by sledge hammer, as well as other control devices thereon. The direct connected generator and exciter can be permanently put out of operation with a block of explosives detonated in the opening between the fly-wheel and the generator.

102. Fig. 66 illustrates the control panel for the three Diesel generators shown in Fig. 65. The size of the bus bar arrangement at the top rear of the panel indicates the presence of dangerous voltages behind the control board, and, therefore, care should be exercised in destroying the wiring arrangements at this point. Three or four carefully placed TNT blocks would probably so demolish all of the control equipment that it would require complete rebuilding before it could be put in operation.

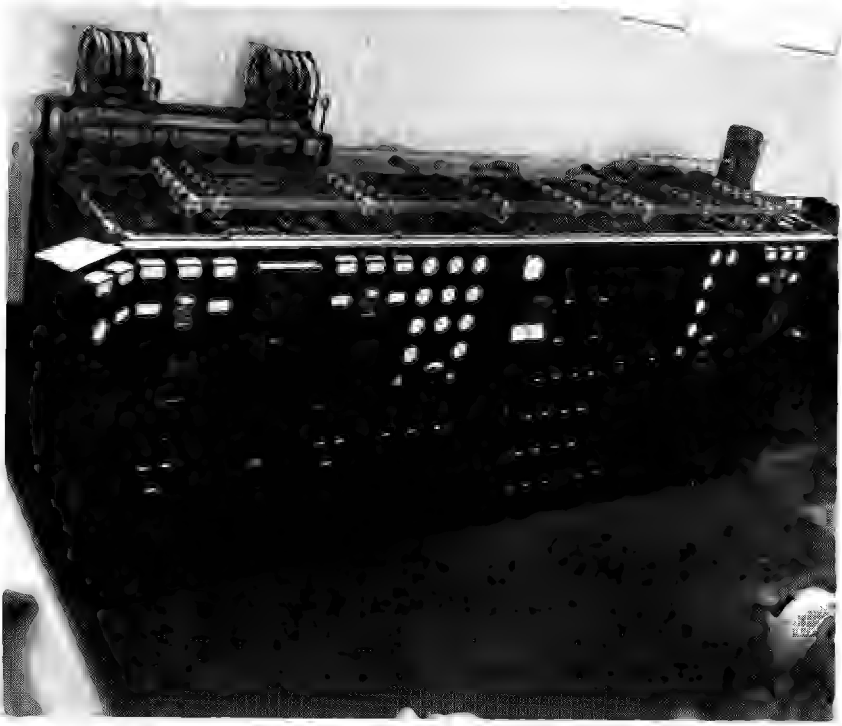


Fig. 66. Control panel

TRANSMISSION LINES

103. The transmission lines with which power is carried over large areas and wide distances is hardly worth the effort to destroy. To short a transmission line by falling the towers or severing the wires, would throw the nearest circuit breaker and probably render that particular circuit useless for two or three days, until an emergency wiring system could be installed at the breach. However, these transmission lines do cross areas that are easily reached by surface troops and the nuisance value of wrecking a section thereof would probably be worth the small effort and risk required.

104. Transmission lines are usually carried by the familiar steel towers or wooden poles with one or more heavy copper wires; and due to the extremely high voltages carried all personnel are warned never to approach the wire area. Damage should all be done near the ground, preferably by toppling over the towers and severing the poles. This should be done where the line describes a curve or corner in order that upon severing the poles or tower the weight of the wire would pull them inward to the ground. In order to do this effectively, it will be necessary to detonate simultaneous charges on several towers within the curve or corner. The poles should be severed as far above the ground as practicable by the familiar necklace type charge, and those legs of steel towers on the outside of the curve should be severed as low as possible and under the lowest bracing members.

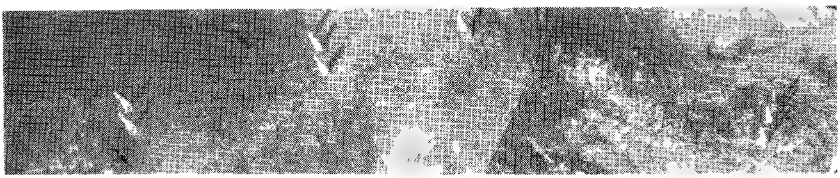


Fig. 67. Steel tower power line

105. Fig. 67 shows a high voltage transmission line mounted on triple steel towers of the conventional four leg type. In this figure the line is describing a curve and preferably all four sets of towers in the curve should be fallen. However an effective job of line disruption and shorting could be accomplished by severing the two outside legs on the two outside towers, as the wire weight and pull would undoubtedly crash these towers into the middle transmissioı line and short both.

106. Unless the ɜstruction of transmission lines were part of a wide scale attack on the po er facilities of a grid system, an isolated attack of this nature would ha e only nuisance value.

POWER—AVIATION

107. All power plants, regardless of type, present a very vulnerable target to air attack as they are highly concentrated units, where every foot of space is occupied by important machinery, and are easily distinguished. Fig. 68 illustrates a modern type of steam electric power plant installation, showing the conventional boiler house with two short fixed draft stacks, the turbine room skylighted over the turbines, the switchhouse in the small three-storied structure adjoining the turbine room, and the switch and transformer yard located near the water tower. This plant obviously burns fuel oil as the large supply tank is shown in the diked area in the foreground.

108. In an attack on this target no particular value would be gained by breaching and firing the oil tank other than of a temporary nature. The principal target for the aerial bomber is the skylight area on the turbine building. As has been discussed elsewhere in this chapter, the boilers are much less vulnerable and more difficult to damage than the turbines. Therefore all effort should be centered on this portion of the building.

109. The small bridge-like structure at the head of the inlet, and near the turbine building, is the point of entry of water into the condenser room. At this point will be found trash racks and control gates, and from here the water is pumped by the circulating pumps described elsewhere in this chapter through the condensing system. The discharge is probably located on the other side of the powerhouse building. This intake is also an important target, and in this particular instance is located so close to the turbine house that a miss on the latter would probably disable the condensing system. Substantial damage here is difficult to repair and might require several months, as a coffer-dam would be required before below water level reconstruction could be started.

110. Fig. 69 is a vertical view on a 1"=500' scale of a very large steam turbine generating station. Here the same building arrangements will be found as have been discussed elsewhere in this chapter, and the four principal target areas should be determined. These are the turbine rooms of the three separate plants, and the water inlet through which the condenser water is secured.

111. The transformer station is of secondary importance, and should be destroyed only after the mission against the turbine buildings has been completed.

112. Only temporary delay would result from the bombing of the three large fuel oil tanks at the bottom of the picture. As this plant probably has

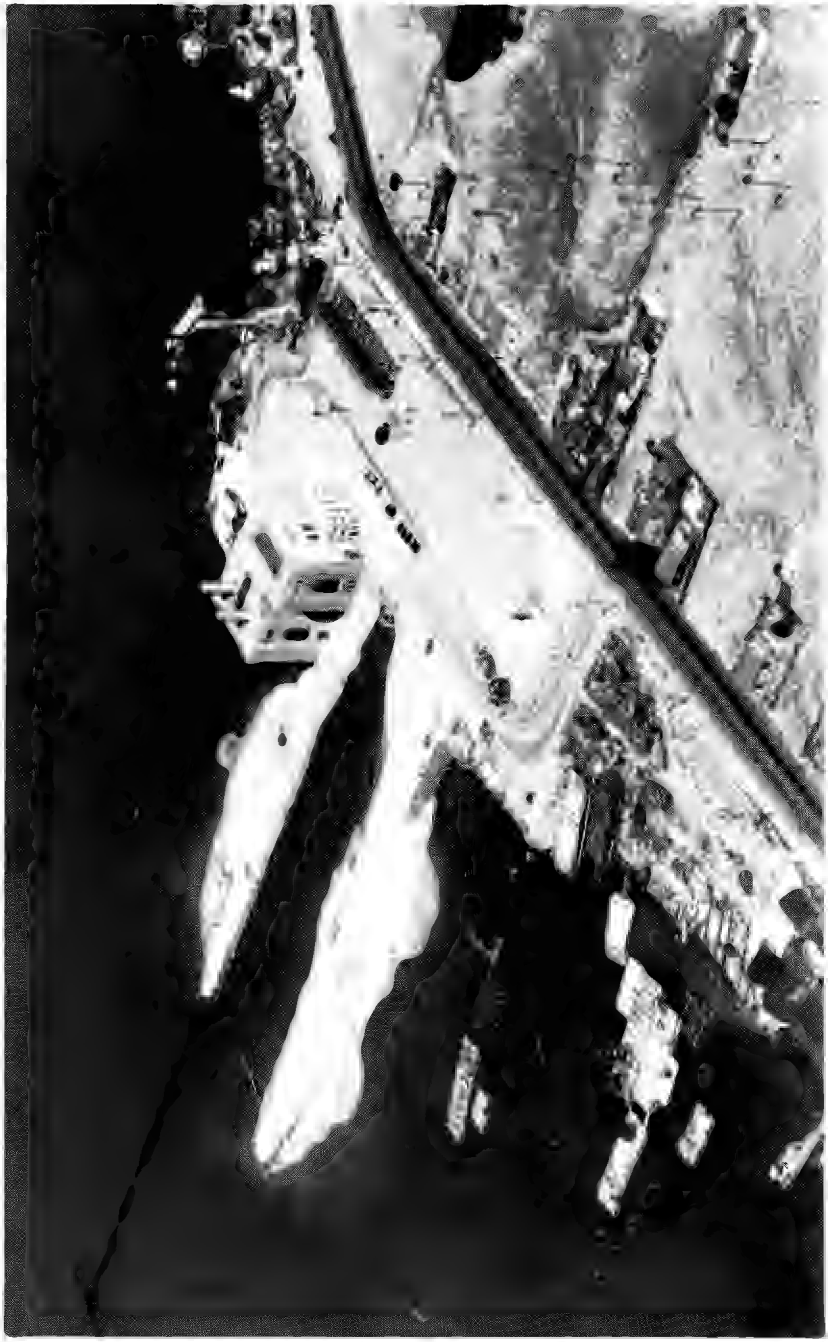


Fig. 68. Steam electric powerhouse

Fig. 69. Steam electric power plant

an alternate natural gas system, or other fuel oil sources of supply, it could probably be put back into operation very quickly.

113. Fig. 70 is a vertical view, on a scale of 1"=1000', of a hydro-electric development in mountainous country. The pipe line bringing the water from a diversion dam or other source some distance away is shown coming up from the bottom of the picture to the surge tank at the top of the hill. From the surge tank two penstocks with four concrete anchor and valve areas carry the water down to the turbines in the powerhouse on the stream below.

114. The critical area for aerial attack is, of course, the tallest portion of the powerhouse, as here are contained the generators and control equipment. The lower building where the penstocks enter the structure is a combination anchor and penstock dividing, concrete base, and is probably of sufficient thickness to resist bomb damage unless a hit were gained at the exact point of entry of the pipes into the building. However, a hit with a delayed action bomb on the turbine house would probably destroy or seriously damage all generators in the room.

115. The arch-type dam visible in Fig. 70 plays no part in this particular power development as the level of the water impounded thereby is below this entire unit. This is probably a diversion dam for another powerhouse to be found down stream off the left of the figure, as an intake house and trash boom can be seen upstream from the dam. The second powerhouse would be put out of operation by destruction of this dam, or the intake building.

116. In Fig. 71 is shown what is normally called a receiving station. The purpose of this unit is to step down the extremely high voltages coming in, probably from a hydro-electric plant at a distant point, over the transmission lines on the large towers in the immediate foreground, to voltages low enough for the normal transformers to handle.

117. The size of the yard and of the transformer equipment indicates that this is not an average transformer station and designates it as one of the most important links in a grid system. A receiving station of this nature should receive as much attention from the attacking group as is accorded the principal power stations.

118. A typical modern Diesel power plant is illustrated in Fig. 72 with the generator building being the principal structure. This building obviously houses five very large Diesel generators as each carries two exhaust stacks and a very large water cooling tower. The building was apparently constructed to accommodate three additional units at a later date. The trans-

former station is shown at the right of the building but it is apparent that the transmitted power leaves the plant by an underground system.

119. While this plant is comparatively small and a hit at almost any point would do considerable damage, the point of aim should be in front of the exhaust pipes in the generator building, where the five generators are obviously located.

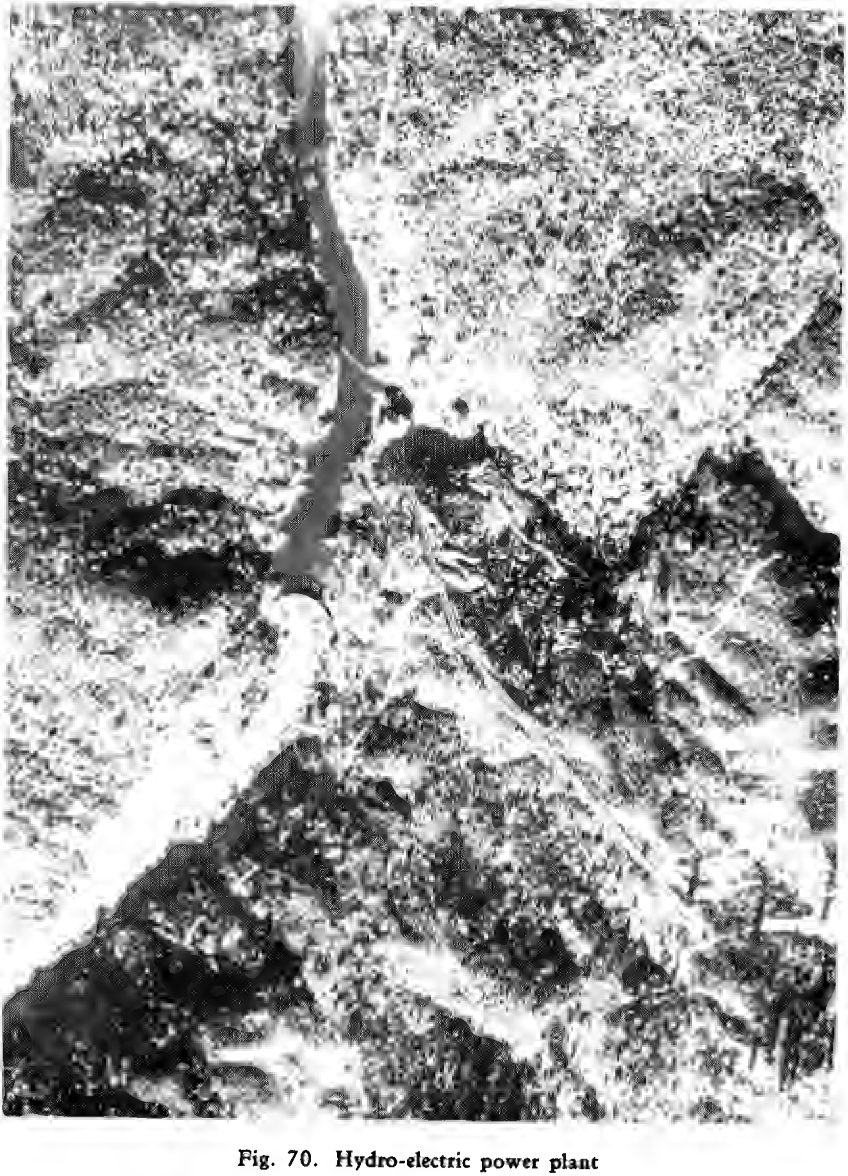


Fig. 70. Hydro-electric power plant

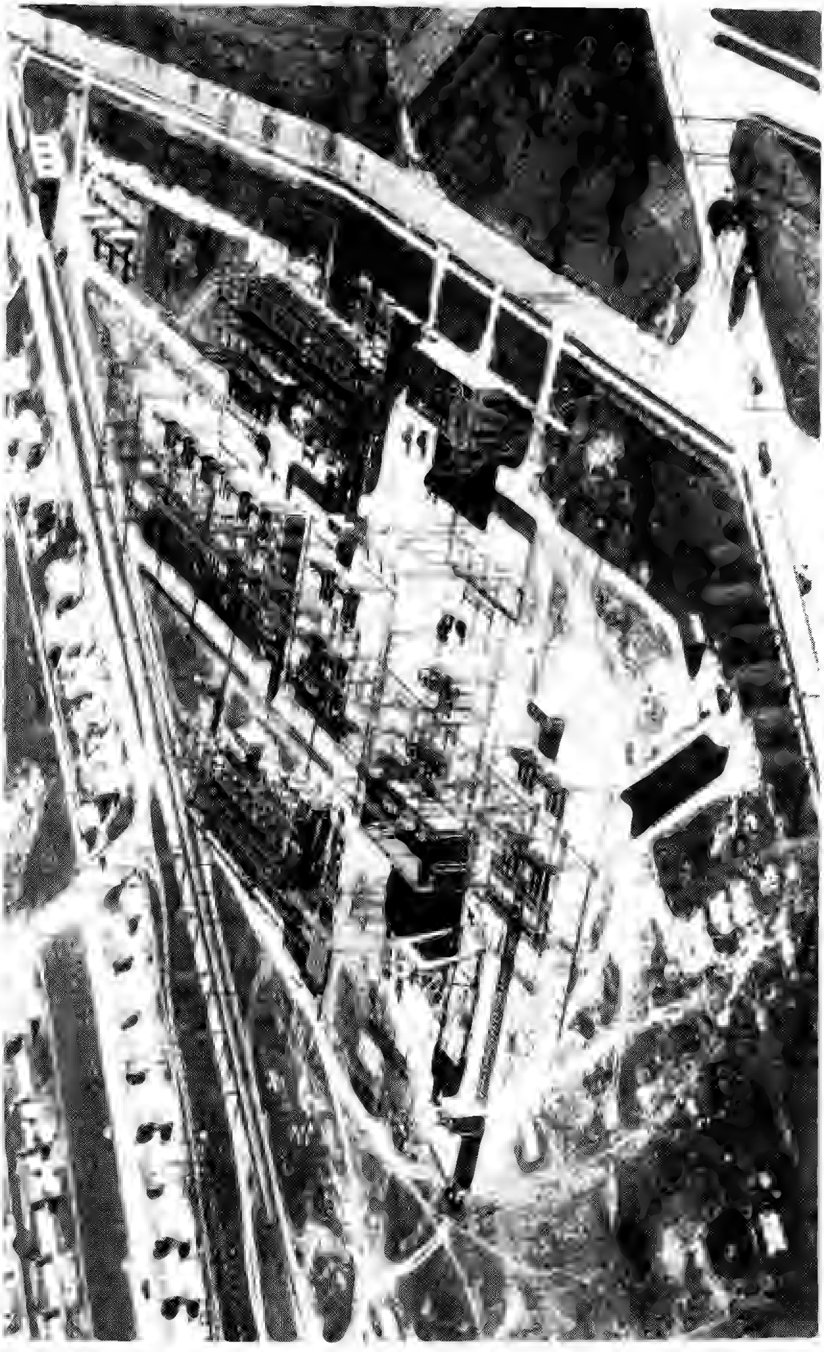


Fig. 71. Receiving transformer station

Fig. 72. Diesel electric plant

WATER SUPPLY

1. Uninterrupted water supply is essential to the domestic life and industrial activity of any community, and the destruction or diminishing thereof will have a serious effect upon civilian morale, a substantial reduction in production capacity, and will permit fires to burn with the greatest destructive results.

Fig. 1. Reservoir created by two earth-filled dams

2. Any mission either by air or surface which contemplates large area fires, in all but chemical plants and petroleum industries, should include a plan to destroy the source of the water supply leading into the area to be burned, as well as the supply of reserve water in reservoirs and pressure mains within the target area.

3. Water is secured from a number of different sources but principally through the impounding of water in mountainous areas by dams, and the leading of this water to the consuming area by aqueduct or pipe line.

4. Fig. 1 shows a typical reservoir area wherein water is impounded by two earth-filled dams indicated by the letter (a). The intake for this dam, through which the water enters the pipe for transmission to the area where it will be used, is circular in shape and located at left center (indicated by arrow), and the point at which the pipe emerges from the dam is seen at the lower left of the intake.

5. Each metropolitan area in any country will usually contain a number of dams such as these, which supplement other water obtained through deep wells, rivers or natural lakes, and the impairment of this source of water supply would have a serious effect upon the industrial production capacity and fire fighting ability of any community.

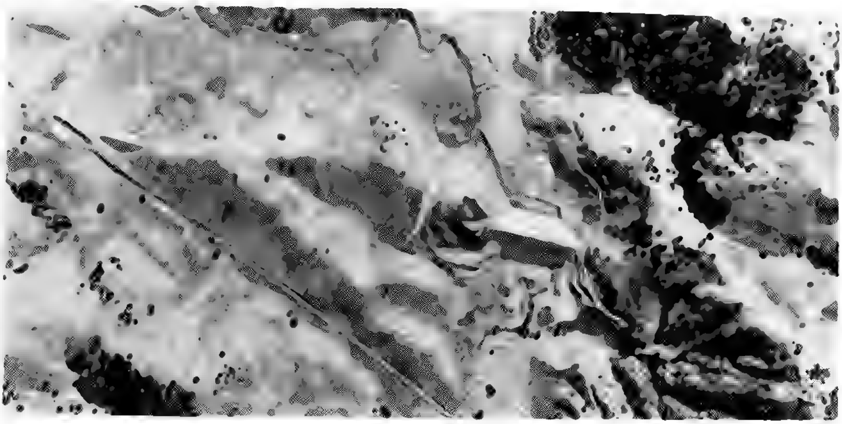


Fig. 1a. Small earth-filled dams under construction

6. The target of first importance for either ground or aerial missions is the intake described above. This intake house usually contains the gate control mechanism which regulates the flow of the water through the pipe line. The surface detail should destroy the operating mechanism of this intake, and rupture the sides thereof below the water line by lowering a sufficient charge of TNT into the column to the bottom of the water level therein, and exploding the same at that point. After the charge of TNT has been prepared, which will usually require anywhere from 50 to 100 blocks of TNT, a suitable weight of metal or stone should be attached, in order to insure the charge being placed at the bottom of the intake cassion.

7. At the same time the pipe line should be severed at the point of emergence from the dam or hillside, by the placing of a sufficient charge of TNT in necklace form around the pipe. Destruction in the manner indicated above will make it impossible to repair or control the water supply until the reservoir is empty, and even then only after considerable time has elapsed, and water flow damage has been done.

8. An aerial attack should be directed against the same two objectives as a great deal more damage would result here by a hit or near-miss than could be obtained by direct hits upon the dams themselves. Dams of this type present extremely strong resistance to any destruction effort due to the immense amount of material employed in their foundations. Fig. 1a illustrates the appearance of this type of earth-filled dam before the reservoir is filled and why it is capable of great resistance to normal bombing attack.

Fig. 2. Arch type dam

9. Another dam known as the arch type is illustrated in Fig. 2 and here the method of attack and destruction would be exactly the same as discussed above. The intake controls are located in the intake house located at the center of the arch of the dam. The pipe line outlet is visible at the foot of the dam and is subject to the same attack and method of destruction as indicated above.

10. Dams of this type secure their strength from the form of the arch and the anchoring of the wings or ends thereof against natural foundations. Should it be desired to destroy a dam of this type by aerial attack by bombing, the point of aim should be in the deep water at either wing of the dam, indicated by T-3, where the shock would be greater because of water backing, and would exert the greatest influence against the juncture of the dam and its wing anchor foundations.

11. Torpedo attacks from up stream against a deep dam of this type might be normally very effective but usually important dams are protected up-stream two or three hundred feet by a torpedo net.

Fig. 3. Gravity type diversion dam

12. A gravity type dam is illustrated in Fig. 3 which also shows an aqueduct leaving from either wing of the dam. This is a diversion dam and not high or massively built. The point of attack from the air or surface is the area directly in front of the spillways. If possible, the tamping or backing effect of water should always be utilized in setting an explosive charge. Surface units should place the weighted charge against the upper side of the dam at the desired point and lower and secure it against the point where the explosion is to take place.

13. Aerial units should always direct their bomb attack just upstream from the exact target. The explosion of any charge under six or eight feet of water, if within several yards of the target, will create more damage than a direct hit on the superstructure.

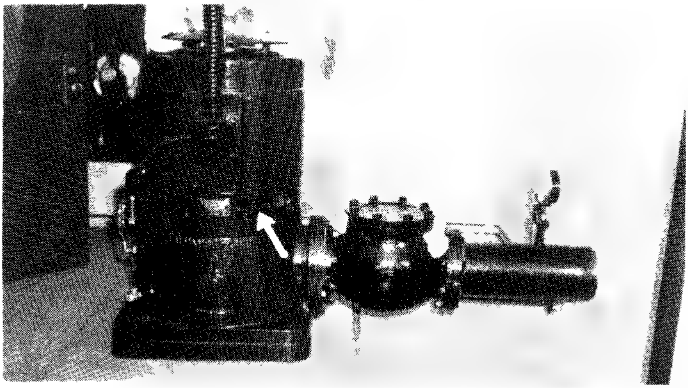


Fig. 4. Deep well electric pump

14. In addition to the sources named above, water is also secured from wells, both pumping and artesian. In artesian wells the water flows normally to the surface without aid though it may be accelerated by pump, but in the case of the pumping well the water must be brought to the surface through a suction or lifting action. Fig. 4 illustrates a typical deep well electric pump in which the pump is located at the head of a vertical shaft, as shown. This pump could be destroyed by placing an explosive charge between the lower motor element and the upper pump housing at the opening indicated by an arrow.

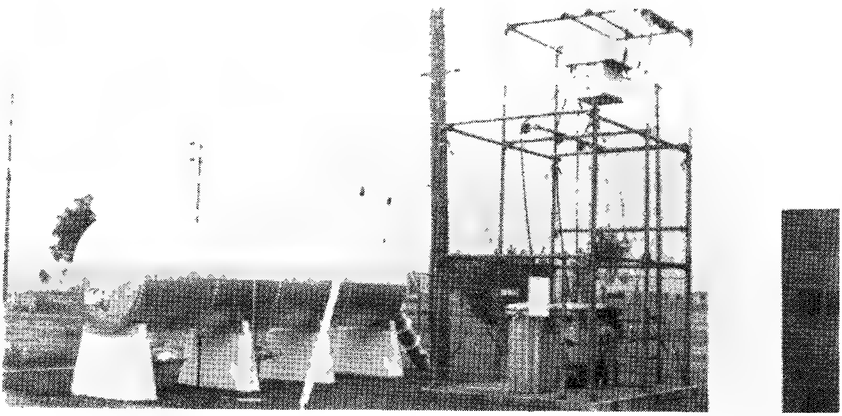
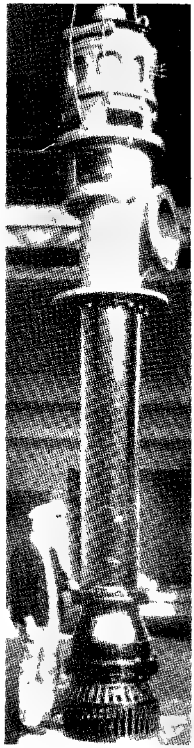


Fig. 5. Deep well pumphouse, transformer and settling tank

15. These pumps are usually contained in a pumphouse similar to the one shown at the right of Fig. 5, and a number of these may be found in the general well area. The transformers in the cage, and the circuit breaker above, should be rendered ineffective by firing two or three rounds from small calibre weapons into the bottom of each. The horizontal tank is merely a settling system to remove sand from the water and is considered unimportant for destruction.


Deep well pump

16. It may be pointed out that the deep well type of water supply is ordinarily not the principal source of water to large communities near mountainous areas, although they are many times used as a standby, or emergency source of water to supplement that normally impounded in the mountains, upon failure of same, or when emergency demands exist.

17. Water brought from great distances to a metropolitan area is usually conveyed by open aqueduct or pipe line and the latter may or may not be buried. Due to the remote areas over which it travels, and the consequent difficulty in guarding, it becomes reasonably easy to gain access to effect destruction.

18. The pipe line or aqueduct itself can be ruptured with explosive charges but this should always be done at a curved section thereof. At points where aqueduct or pipe lines pass under roadways or waterways, the aqueduct syphon and the pipe line are the most vulnerable spots to attack with explosives. These sections were especially made for this one location and would require the building of a new unit before service could be restored.

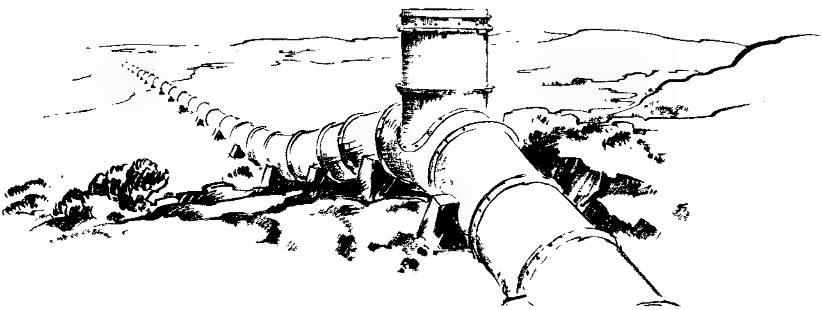


Fig. (a) Covered overflow pipes are sometimes located on minor summits

19. The pipe lines issuing through or from mountainous country require air valves at each minor summit and depression along the line, to avoid collapsing the pipe in the event of a rupture down stream and a consequent accelerated rate of flow of the water. An effective job of destruction can be accomplished by a few men in a short time by jamming these air valves, where found, so that they will not open, and then preceding down stream a convenient distance, preferably several miles and severing the pipe. The pipe line above the rupture will collapse at many points due to the terrific vacuum set up through the increased flow of the water.

20. On the more modern systems overflow pipes are sometimes located on minor summits, perhaps several miles apart with the opening slightly higher than the hydraulic gradient of the line. These are placed in the line for the purpose of preventing, through mechanical valve failure, collapse of the pipe as described above. If one of these is found, it will be recognized because it will be approximately the same diameter as the pipe and may rise to a considerable height above the pipe line; an effort should be made to plug same, and if this could not be done at the protected opening at the top, it could be accomplished by exploding a semi-circular charge of TNT just above the junction of the overflow pipe and the main pipe line.

Fig. 6. Water main gate valve

21. Gate valves similar to the type shown in Fig. 6, will usually be found in the pipe line shortly beyond the point where it emerges from the point of intake, as well as at other points along the line. The pipe above these points is normally built to withstand the pressures created by closing the valve, but in foreign countries this is not always the case. Therefore, the destruction detail should shut these valves wherever they are found on the pipe line, as they proceed upstream, because unless the line is built to withstand the heavy pressures developed thereby, it will probably burst at many points.

22. Normally pumping stations are required to force the flow of water over long distances, and the stations in which these units are housed are extremely vulnerable. Fig. 7 shows a typical pumping plant with a battery of several centrifugal pumps driven by electric motors. A pumping station

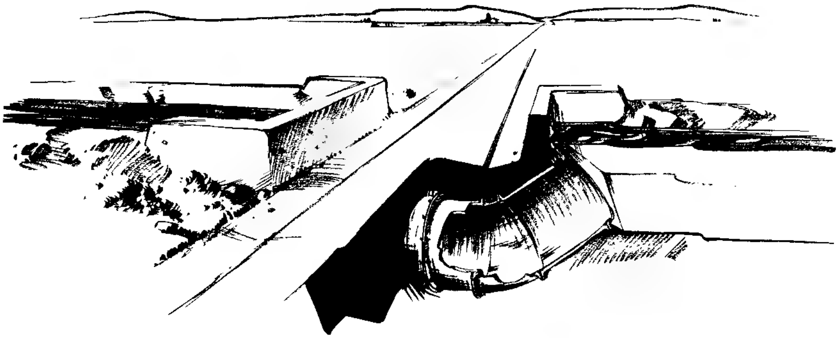


Fig. (b) Attack should be directed against the inverted siphon

of this sort could be along the pipe line in country areas, to move the water along, or in metropolitan areas for the purpose of building up pressures on the feeder mains when fire alarms were sounded. As indicated elsewhere herein, any mission, surface or air, which contemplates the setting of area fires, should plan to destroy these pumping units, both in the area to be fired, and along the pipe line supplying water thereto. Pumping stations will be found at regular intervals on long pipe lines where the water source is lower or only slightly higher than the discharge

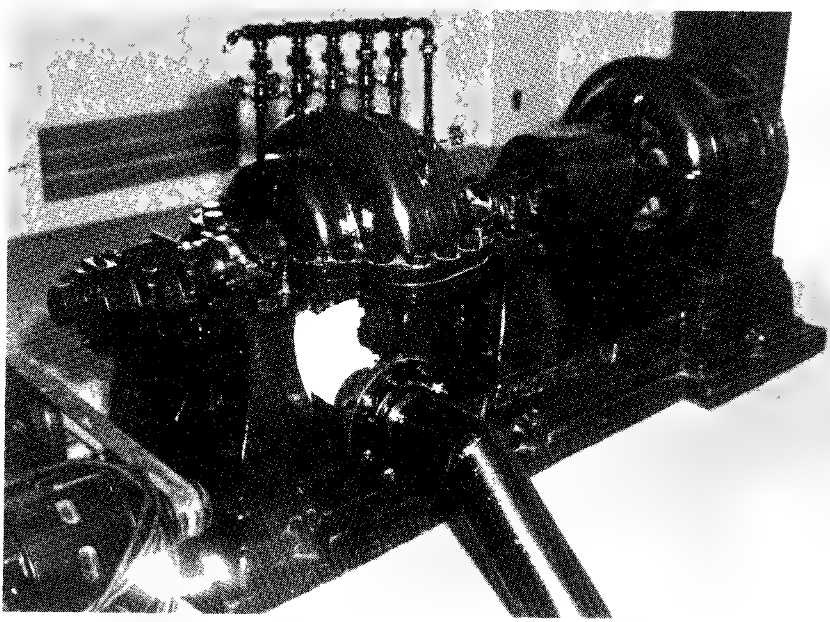


Fig. 7. Centrifugal pumps

area, and also will usually be found in various districts within a city. The first are for boosting the flow of the water and the second are for maintaining water pressures within a using area for both fire and domestic purposes. Power may be supplied by internal combustion engines or by electric motors receiving their energy from transmission lines, or a self-contained generating plant. Pumping stations on aqueduct or pipe lines are easily found and distinguished but within a metropolitan area the in-put and out-put pipes are usually beneath the surface and not readily located.

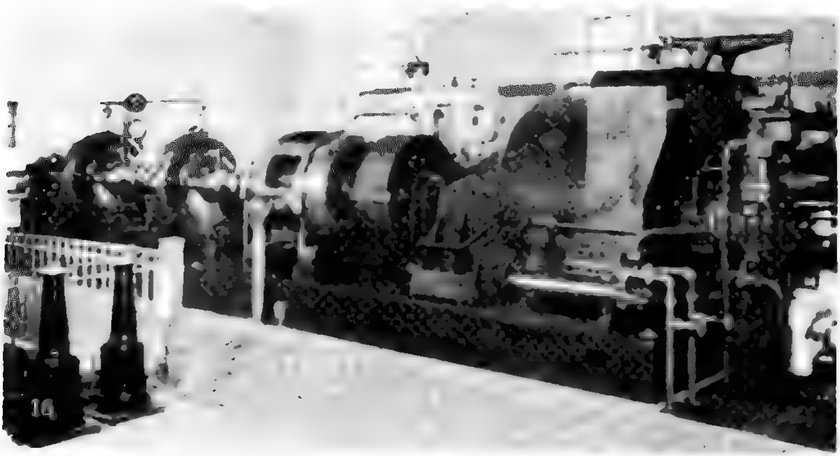


Fig. 8. Steam turbine turning generator and two centrifugal pumps

23. Another type of centrifugal pump is illustrated in Fig. 8, and to destroy same it is necessary only to rupture the casing of the pump with explosives or sledges, and fire two or three rounds into the motor windings.

24. Water purification units, such as illustrated in Fig. 9, while important to the domestic consumer of water, are not considered essential to industrial activity, and may, therefore, be disregarded by the destruction detail. There are several methods of water purification, the principal ones of which, are chlorination and aeration. The plant shown to the right in Fig. 9 is one in which the water is aerated.

25. After water has been brought by aqueduct or pipe line to the area in which it will be used, it usually goes into distribution storage reservoirs. These reservoirs are of many types, one of which, is illustrated in Fig. 10. They may be of sheet metal built above the ground, concrete or natural excavation below the ground, and covered or uncovered, although usually covered to forbid sunlight and the resulting organic growth in the water. These reservoirs are normally located on elevated ground in

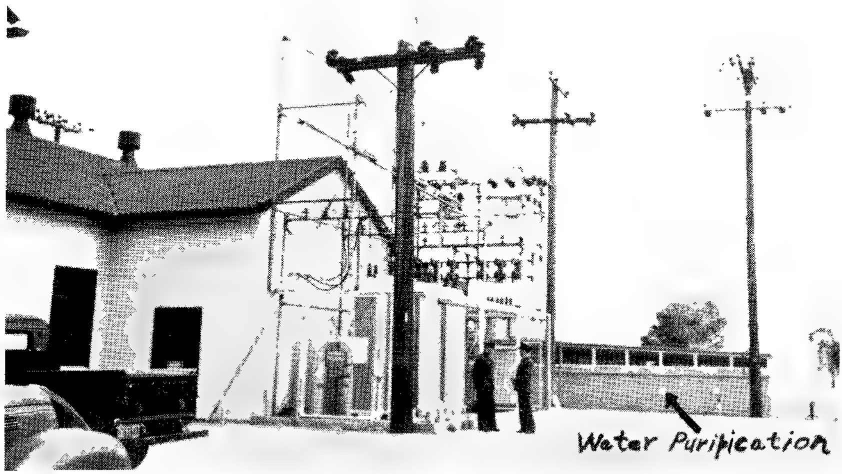


Fig. 9. Pumphouse with purification unit in background

order to secure the advantage of pressure therefrom, but in the absence of elevated areas, are built up in steel stand-pipes and large elevated tanks. These constitute the reserve supply of water for an area and are designed principally to supply the peak loads required by heavy fire draft. Unless these are destroyed, an adequate water supply will usually exist with which to extinguish any area fire in the vicinity.

26. Surface details should wreck the steel stand-pipe type reservoir, indicated in Fig. 10, by placing an explosive charge between the tank and the gate valve at the point indicated by the arrow. Such destruction would release the stored water and render the tank useless for a considerable time.

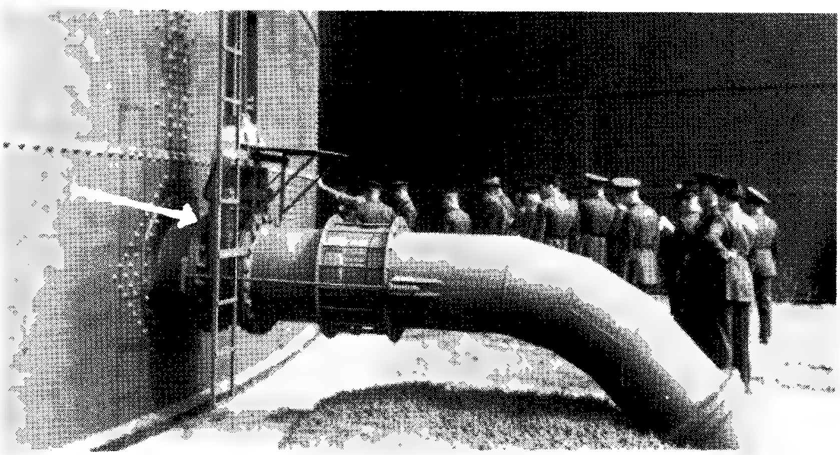


Fig. 10. Steel reservoirs showing gate control valve

27. Other types of storage reservoirs, such as the covered concrete one shown in the upper center of Fig. 11, should be breached at the outlet gate valve, and a charge of explosives should also be lowered into the tank and exploded near the point where the pipe leads out of the side. If the gate valve were destroyed first and then the internal charge exploded, it may, with the aid of the rapidly flowing water, breach or wash out a section of the reservoir side.

Fig. 11. Covered concrete sunken reservoir

28. The type of storage reservoir shown in Fig. 11 is typical in a great many industrial sections, if high ground is available upon which to locate same, and sometimes the reservoir may be located three or four miles away from its principal consuming area in order to gain this necessary elevation. The aerial bombing of this tank would do little to disrupt the functioning thereof, unless a hit were gained on the extreme edge, where the ground falls away the fastest, and the supporting wall of dirt is thinnest. Upon this basis the point of aim against this particular target is indicated by the circle and T-1. Within this area the supporting walls of the reservoir are the thinnest, and the controlling gate valves are located. Here also the center of aim should include some water.

29. Any mission calling for area destruction by fire, either surface or air, within two or three miles of this reservoir, should certainly include the destruction thereof in the plan, in order to reduce or destroy the reserve supply of pressure water with which the fire might be fought.

GAS SUPPLY—NATURAL

1. Gas is an important fuel to the industries and communities of most nations, and in some areas and operations its use is of more importance as a fuel than coal or oil. It is either natural, manufactured, or a mixture of both. This chapter will deal primarily with natural gas as there is a general similarity between the critical operations in the production and storage of natural and manufactured gas.

2. Natural gas issues from gas wells, and is present in varying quantities in most oil wells, from which it is extracted by the simple gas trap method explained elsewhere herein. Manufactured gas is extracted from soft coal, as a by-product, or principal product, of coke making. Some areas use a mixed gas which is a combination of varying quantities of the two.

3. Natural gas is piped from the gas and oil wells through sometimes extremely long pipe lines to a plant where it is treated, compressed, cooled and stored in large gas holders. As has been stated elsewhere herein, these large holders are normally located within the metropolitan area where the gas is used, although they may sometimes be found near wells or refineries where the gas is produced and used for fuel.

4. Normally where great distances exist between the wells and the using community, pumping stations may be located in the intervening distance. These stations are extremely vulnerable as they usually contain two easily destroyed and important pieces of equipment; compressors, and one or more high-pressure cylindrical or spherical storage tanks.

5. The most familiar type of holder is that illustrated in Fig. 1, known as a guide frame holder. These are low pressure, water or tar-sealed, holders that travel up and down within the guide frames, depending upon the quantity of gas contained.

6. The destruction of this type holder presents a difficult problem. The gas therein will neither burn nor explode until it has been mixed with the correct proportions of air. It is considerably lighter than air and rises and diffuses quickly upon release. The effect, however, of an exploding natural or manufactured gas holder is so tremendously destructive as to justify the effort and the time required to accomplish same.

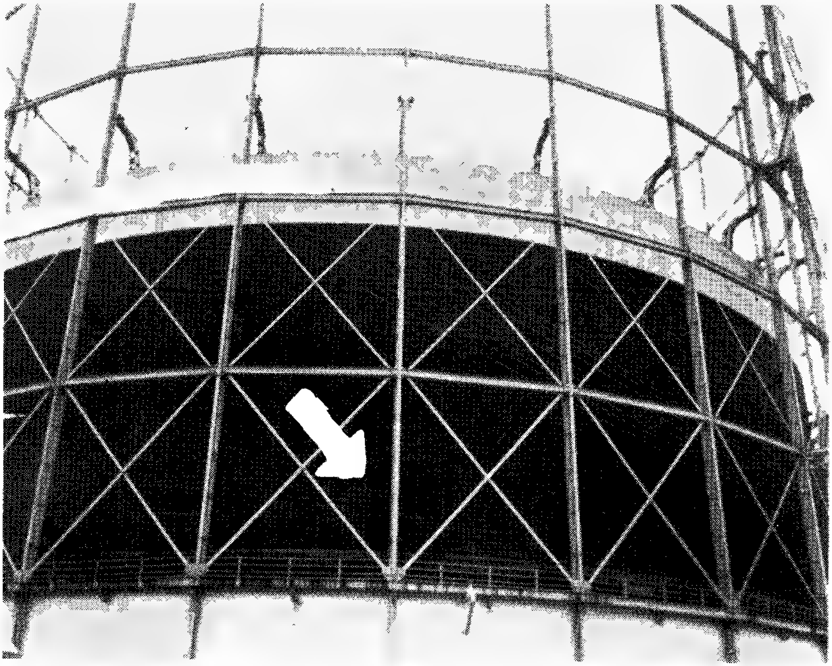


Fig. 1. Multiple lift guide frame gas holder

7. The ground detail should breach the guide frame type holder above the first steel shell nearest the ground. Normally in water or tar-sealed holders these substances extend up into the holder several feet from the ground, and unless the breaching occurs above this point nothing but water or tar will issue from the opening until, of course, the water or tar above the opening has been drained. In the case of a tar-sealed holder, this would require considerable time. Therefore, the charge should be placed in this type holder in or above the area indicated by the arrow in Fig. 1.

8. It is important that some method of ignition of the escaping gas be provided. This could be done by tying a thermite bomb or a burning piece of oil coated waste to the frame work somewhat above the point of breaching. Tracer bullets will provide the necessary spark if fired into the area where and when the gas has had an opportunity to mix with the proper quantity of air.

9. There are many different designs of this type holder, but principally they are divided into two classifications, and these two types will be found in use the world over. These are low pressure and high pressure. The low pressure tanks are again divided into two types and an illustration of each of these types will be found in Fig. 2. The tallest tank is a fixed type,

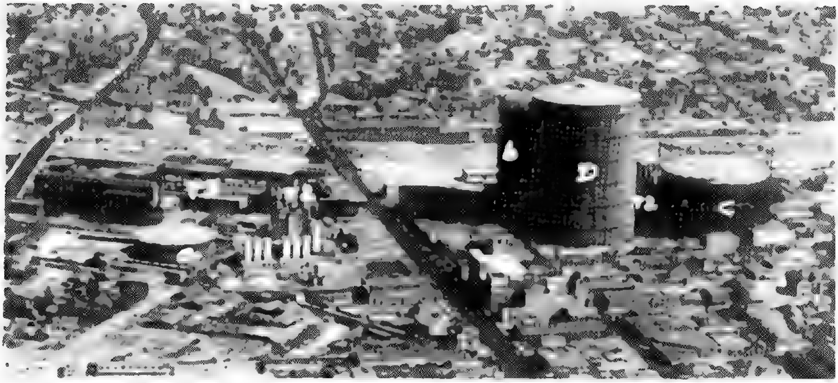


Fig. 2. Gas plant with fixed and guide frame holders

waterless holder in which a sealed piston travels up and down inside, depending upon the amount of gas contained therein. This type of holder should be breached near the ground, and any attack from the air by strafing should be directed at the lower areas, in order to be certain to puncture that section containing gas and not the void that exists above the piston head.

10. The appearance of the two low pressure types of tanks from the air is clearly shown in Fig. 3. A, B, & C are the guide frame, water or tar-sealed, type, while D represents the fixed height waterless sealed type.

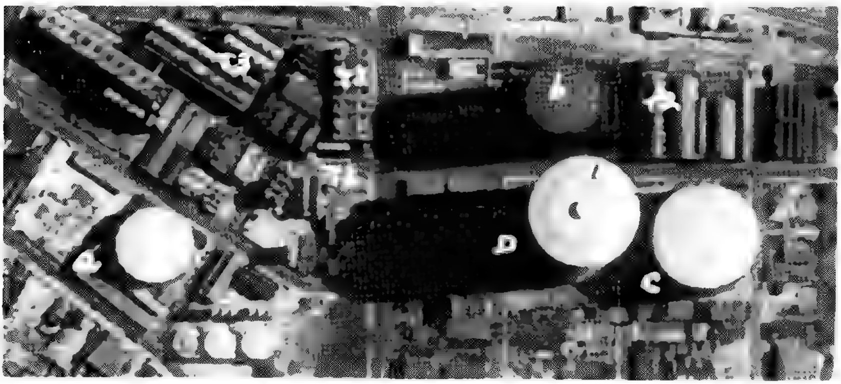


Fig 3. Vertical view of plant shown in Fig. 2

11. Should these tanks be the target of an aerial bombing attack the type shown in A, B, & C should be hit by instantaneous action bombs, while delayed action bombs should be employed against tank D. If this were not done on holder D, the bomb would probably detonate on contact with the roof and blow the upper portion away, but would have no effect whatever upon the gas or the holder in the critical areas below.

12. Other than the storage tank the air compressors are the most important units to a gas manufacturing or storage unit. Figs. 4, 5, and 5a show typical compressor installations, each employing a reciprocating, electrically driven pump.

13. These compressors are very easily destroyed by throwing a heavy metallic object into either the piston or gear-way. A more complete job of destruction can be accomplished by tying down or jamming the safety relief valves located on the air tanks, and then closing the air output valve therefrom. The compressor will build up the pressure in the air tank within a few minutes until the same bursts, and this normally will be of such sufficient force to demolish most equipment in the building.

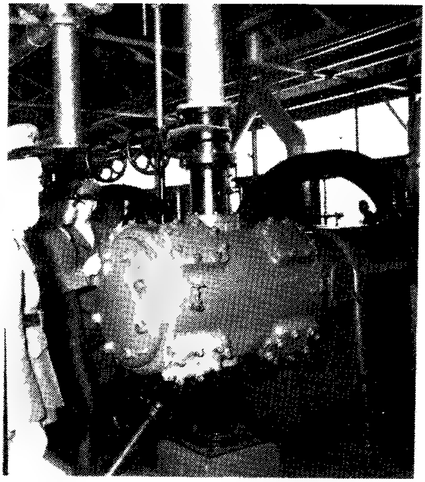


Fig. 4. Gas compressor, reciprocating type

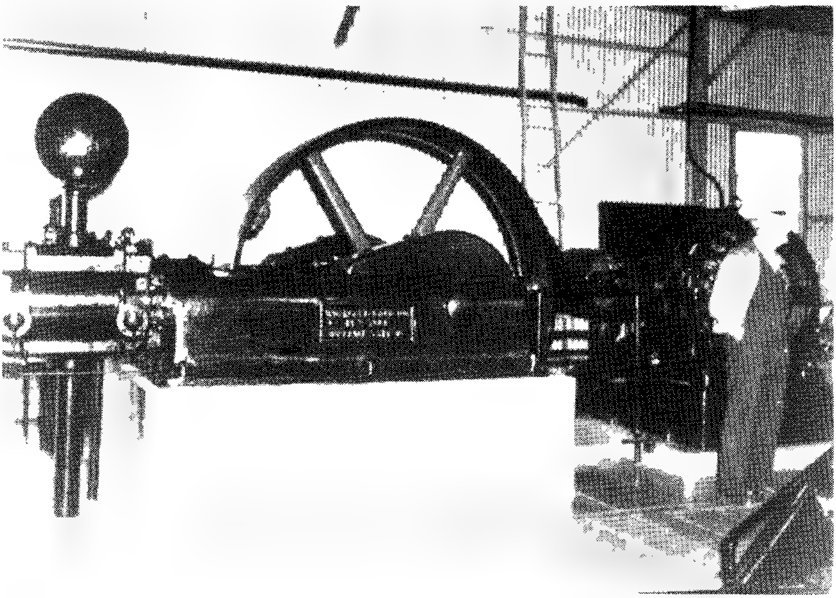


Fig. 5. Compressor and electric motor

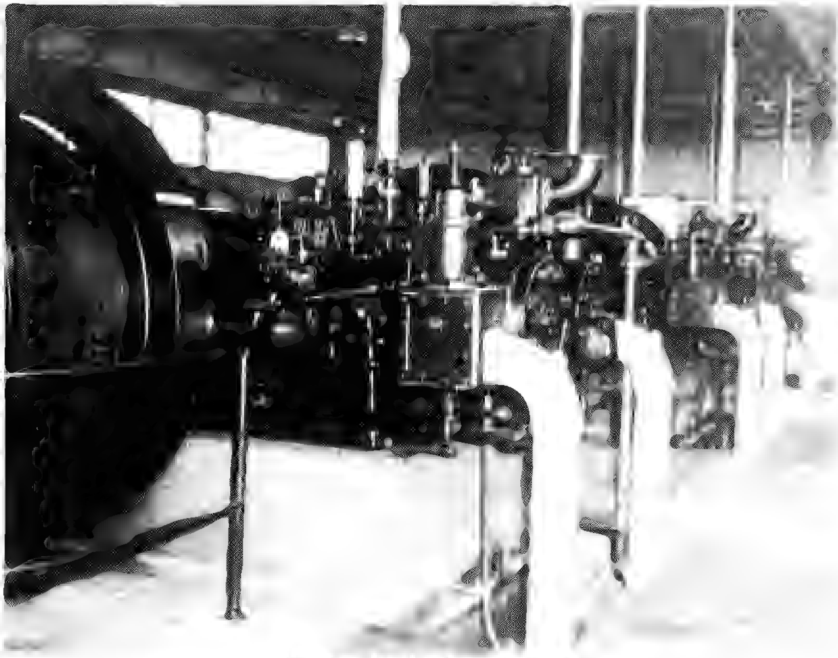


Fig. 5a. Bank of compressors

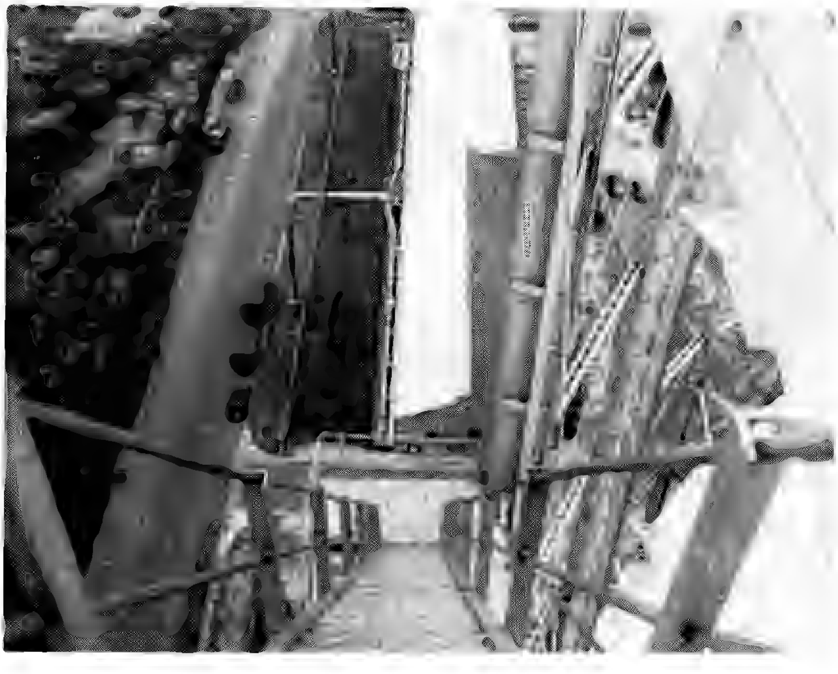


Fig. 5b. View of compressor house from guide frame holder

14. A typical example of what happens when a gas compressor, or its tank, explodes, will be seen in Fig. 6. In this particular case it was gas being compressed which became ignited after the tank exploded, and a very successful job of destruction was accomplished.

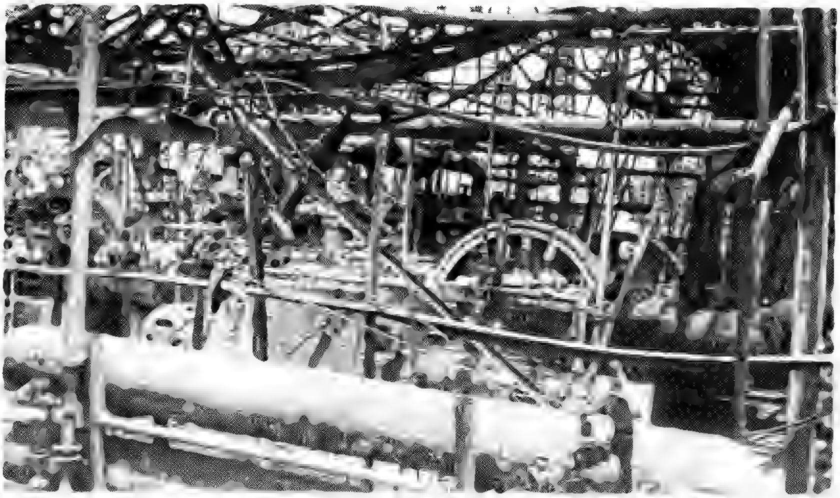


Fig. 6. Wreckage caused by exploding gas compressor

15. In Fig. 7 is shown the lubrication system of a reciprocating compressor, which is an important part of the engine. If this unit were destroyed by a few blows from a sledge hammer, the resulting lack of oil would cause the entire compressor to burn itself out in a comparatively short time, and

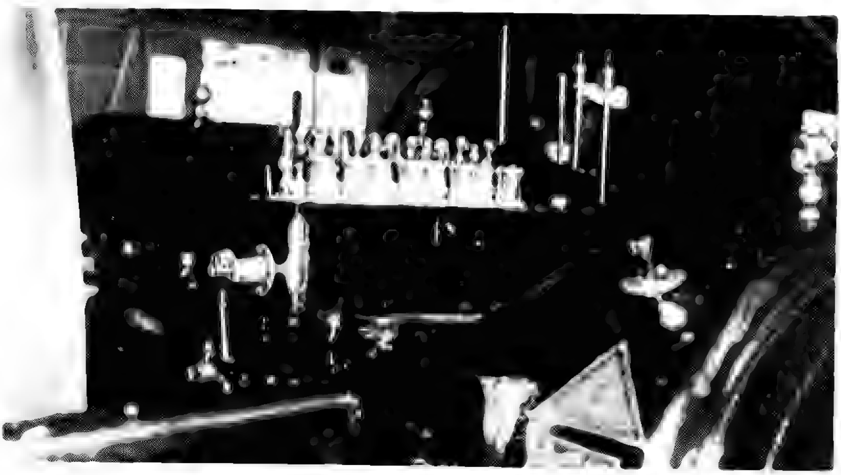


Fig. 7. Compressor lubricating tank and valves

freeze all moving parts to such an extent that several months would be required for its rebuilding. In this connection, however, a more complete job of destruction can be accomplished if the power of the engine is used to build up explosive pressures within the system.

Fig. (a) Gas shut-off valves, controlling city sections

16. At each plant area will be found, either housed or in the open as shown in Fig. (a), a series of valves which control the supply of gas into various sections of a city. As can be seen in the figure these are normally of a special type and should be destroyed by explosives or thermite wherever possible. The destruction of this unit, if contemplated, however, should not be planned after the breach of the gas holder, as the proximity

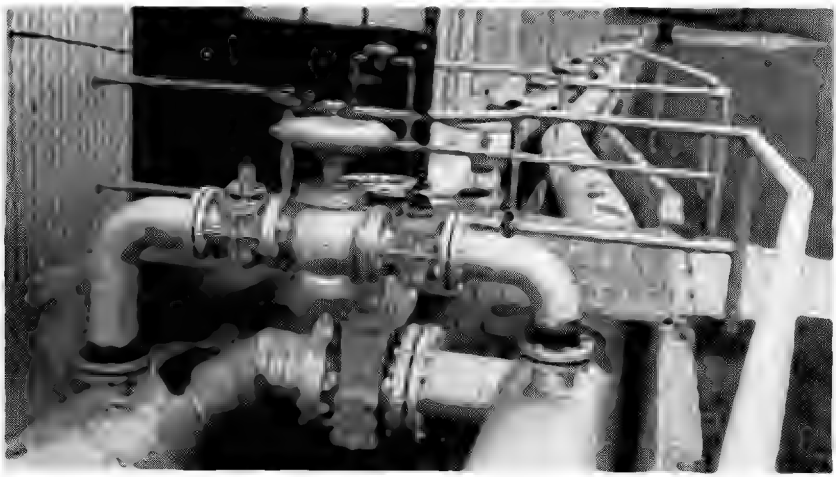


Fig. 8. Gas lines from compressor house

of the two will make close approach impossible thereafter. One or two of these control valves, however, could be breached and fired before action was taken against the holder itself. The heat of the burning gas issuing from one of these valves, if allowed to burn for a period of a few minutes, would be sufficient to destroy the others, and any other equipment in the immediate vicinity.

17. Around a gas plant will be found many pipes similar to those shown in Fig. 8, and for a complete job of destruction these should be demolished. This particular piping arrangement shows the compressor house and six pipes issuing from probably six compressor units therein. Any breaching of these pipes with subsequent ignition at this point would cause considerable damage.

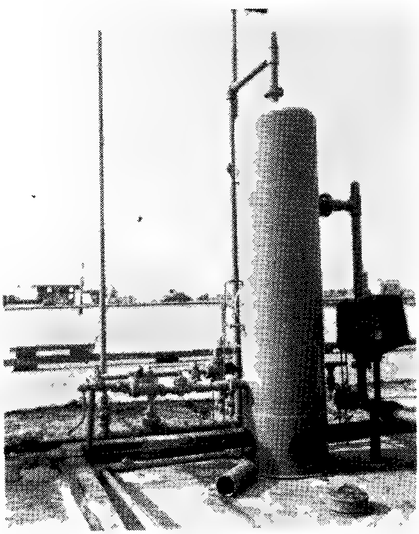


Fig. 9. Oil well gas trap (casing head gas collector)

18. One installation of minor importance, which has been discussed elsewhere in this manual, is shown in Fig. 9. This has been identified as a gas trap or casing head gas collector, which is the unit normally located in the oil field, and which separates the gas from the flow of oil from the well. These would be important to destroy only if the natural gas supply of a refinery within the oil field itself were being considered.

GAS SUPPLY—AVIATION

19. Some reference to aerial targets has already been made in the preceding paragraphs but herein it is intended to identify certain other targets within the gas plant area.

20. It is desirable to study Figs. 2 and 3 closely in order to identify, in their relative forms and location, the various units of a large natural gas plant, obliquely and vertically.

21. The tremendous size and usually strategic location of these units is such as to preclude effective camouflage, and their importance to the industrial production capacity of an area certainly distinguishes them as one of the most important targets of a raid.

22. T-2 in Figs. 2 and 3 shows the compressor houses, which are the targets of second importance with and after the gas holders.

23. The compression of gas, especially in the higher pressures, produces a high temperature which must be cooled before being discharged into the holders or into the mains. Therefore, the after-cooling facilities of a gas plant are extremely important to production. T-3 in Figs. 2 and 3 indicates the after-cooler building which is the target of next importance.

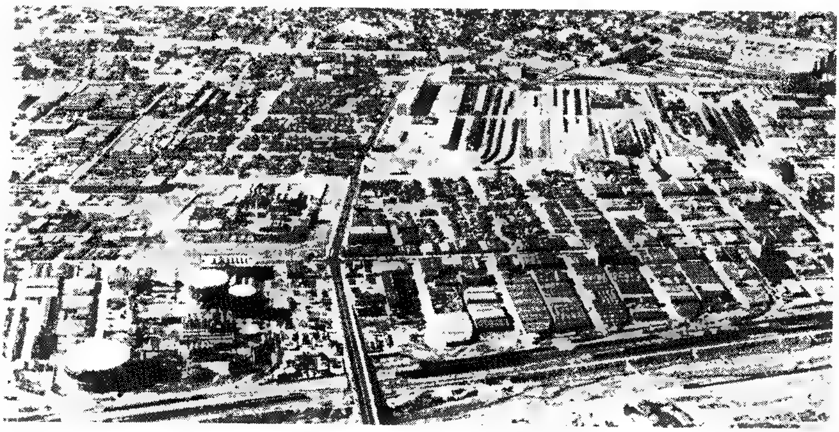


Fig. 10 Area oblique showing gas works and freight unloading yards

24. Fig. 10 is an oblique of another gas works showing three different size guide frame holders in various stages of their capacity. It must be evident that a fire of these highly combustible gases would do a tremendous amount of damage over the entire area.

25. It is also evident that breaching and ignition of the tank in the upper right hand corner would probably destroy, by explosion and fire, all of the large warehouse type buildings, and the railroad cars, in the vicinity.

26. Fig. 10 also gives an opportunity to study the points of a bombing attack on important railroad yards. As is covered elsewhere in this manual, the target for greatest destruction would be where the largest number of switch points are gathered, which has been indicated in this figure.

Fig. 11. Gas holders

27. In Fig. 11 will be seen, gathered in one comparatively small area, the seven holders which supply about 60% of the gas requirements of a large American industrial city. The narrow limits of this target area, and the importance to the industrial life of the community combine to establish this as one of the most important targets of an aerial bombing mission.

28. Of interest also in Fig. 11 is a natural water storage reservoir in the hill above the fixed gas holder, and in the center foreground will be seen a typical steam water pressure pump plant. These two installations become of interest in connection with that chapter of this manual dealing with water.

29. Fig. 12 presents another opportunity for vertical study of a smaller gas plant operation; the RF is 1″=500′.

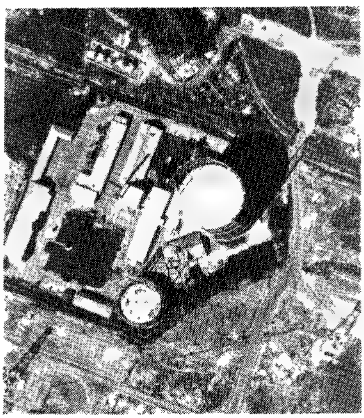


Fig. 12. Vertical view of gas plant

30. In Fig. 13 will be seen a very large industrial plant obviously engaged in the manufacture of liquid chemicals. This becomes apparent upon examination of the many cylindrical tanks, obviously storing a liquid not under pressure, due to the absence of the hemispherical ends, and due to the fact that all tanks including the vertical are contained in dike yards. Unless the product of this plant were known, so that

the most vulnerable point therein could be predetermined, the target of first importance in this instance would be the gas holder (T-1), both for aerial and surface attack.

31. The second target of importance, or possibly of equal importance to the gas holder, would be the power house designated by (T-2). In this particular case the stacks are probably high only to carry away objectionable gasses. Therefore, the stacks themselves are not important, as they could be replaced quickly by short stacks with blower arrangements. However, this building undoubtedly contains steam turbine generators located in that portion of the building outlined in white, and it is at this point that the aerial attack, and the activities of the surface detail, should center.

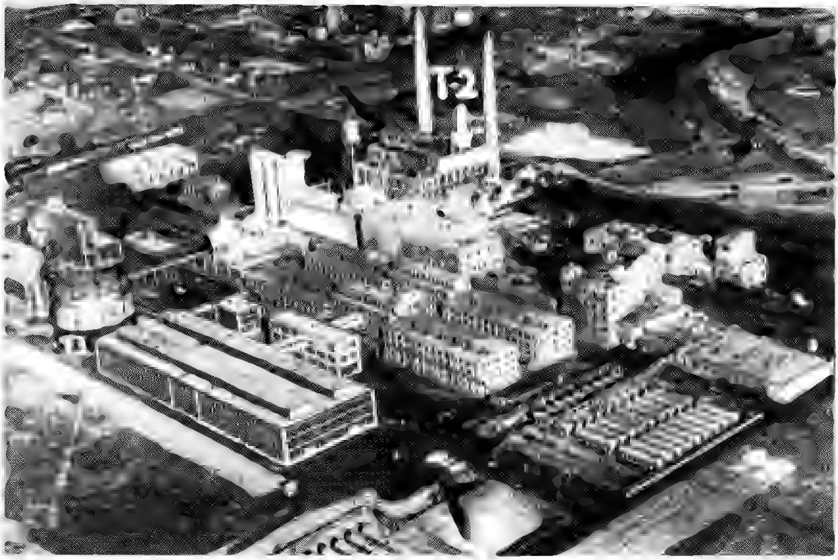


Fig. 13. Chemical plant with manufactured gas holder

32. Should the tank (T-1) be breached by surface units, the breaching should be at the point indicated by the arrow in order that the issuing gas stream would be directed toward obviously critical buildings. As explained elsewhere herein, the top of the guide frame holder should be the target of the aerial attack.

33. It is again pointed out that any breaching of this tank from the surface, or from the air, should be deliberately accompanied by the release of ignition or incendiary agents.

RADIO COMMUNICATION

1. In order to interrupt and possibly stop the principal means of communication to an enemy, it would be considered advisable to destroy, in addition to telephone and telegraph, all radio broadcasting facilities. This action is considered advantageous in order to inject as much confusion into a mission of destruction as possible. The destruction of communication facilities may also be considered necessary as a prelude to large scale raids, or invasion, in order to isolate the area or section involved from communication and early assistance from outside sources.

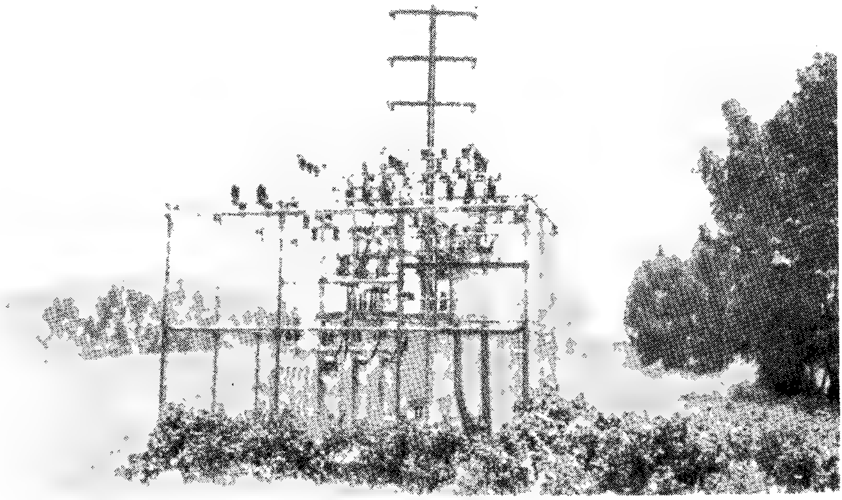


Fig. 1. Transmitter transformer station

2. Within the normal military zone or metropolitan area, will be found several small broadcasting organizations and possibly three or four civilian or military units with a high KW transmitting capacity. The smaller broadcasting companies will normally use a regular source of AC power, secured from the existing 110 or 220 volt domestic circuit. In larger installations, however, the external source of AC power will consist of high voltage transmission with a step-down transformer similar to the unit shown in Fig. 1, which will usually be located in the building housing the transmitter, or immediately adjacent thereto. These transformers may be

of the type shown in Fig. 1, or of the more familiar "ash can" type, either pole or surface mounted.

3. Transformers of this type can easily be damaged by firing small arms ammunition through the casings, but the damage occasioned by this method is inconsequential, as new transformers could be installed within a period of two or three days time. Probably if only temporary delay were desired, this method could be utilized, or sections of chain or wire cable could be thrown over the bus bar wiring appearing at the top of the installation in Fig. 1. This latter operation would put the transmitter off the air for only a matter of a few hours until new fuses were installed and circuit breakers reset.

4. Ordinarily all broadcasting companies have emergency stand by power units ready for service in the event of a power breakdown in the regular source. These units will normally be housed in the building containing the transmitter station and will be a gas, gasoline or Diesel-driven generator. This unit, of course, should be destroyed or damaged at the same time the transformers are put out of operation.

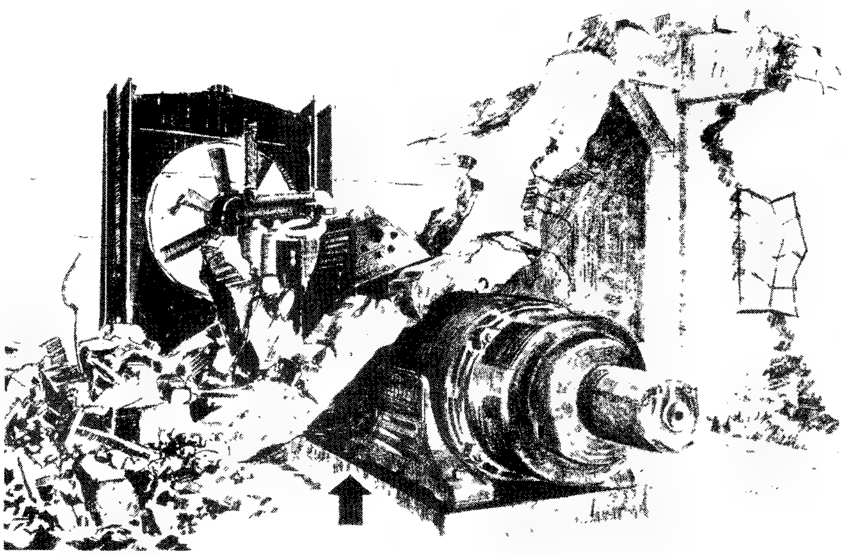


Fig. (a) The stand by power unit should be destroyed

5. The method of destroying these stand by power units is relatively simple as they are normally small and contain many parts easily broken by sledge hammers or explosives. Fig. 2 shows a typical gasoline-driven

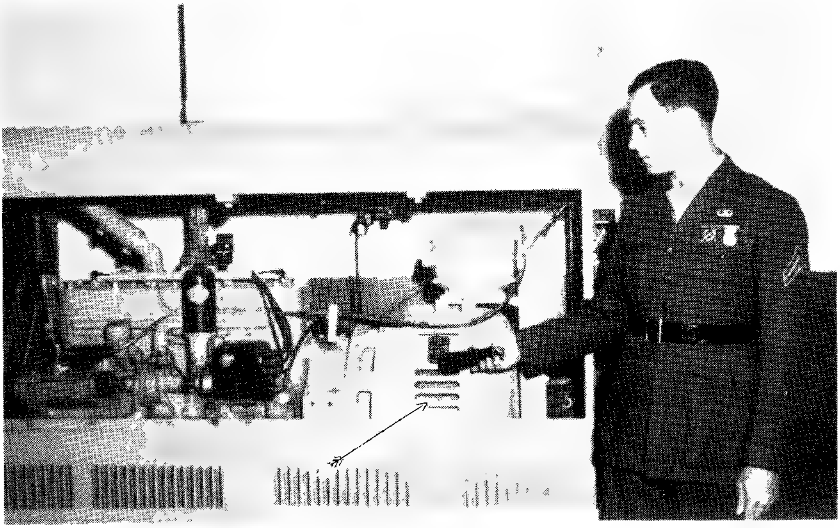


Fig. 2. Gasoline generator for standby service

stand-by power unit, and Fig. 2a shows a large Diesel electric generating unit used where the power requirement is high. This latter unit while large, is subject to easy destruction of both the engine and generator by simple demolition.

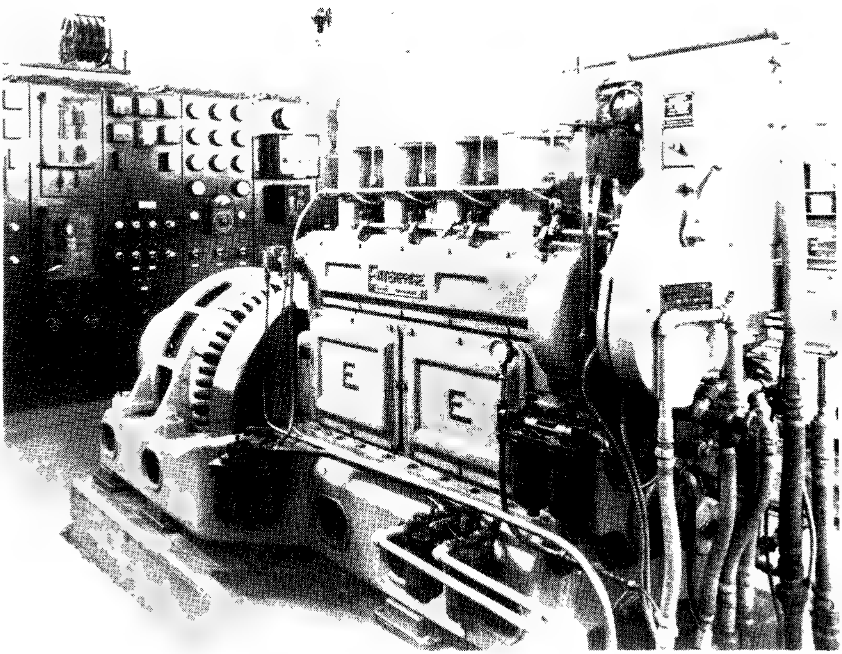


Fig. 2a. Diesel powered generator

6. Battery operated equipment often found in broadcasting stations presents little difficulty to the destruction detail. It is advisable to break the terminal points with a sledge hammer with wooden handle, and save the acid therefrom to be poured over the windings of generators, or the electrical connections on the transmitter panel boards. These battery installations sometimes carry high voltages and the detail should avoid personal contact with any wires or terminal strips, as well as contact with the acid contained in the batteries. Firing small arms through the battery cases is not recommended as it will do little more than temporarily short the equipment and spill the battery acid. New batteries can be installed, or the damage can be quickly repaired.

7. In order to obtain better signal transmission, the actual transmitter station, of the larger broadcasting units, will usually be found in an isolated section, somewhat apart from the metropolitan center in which the broadcasting station itself will probably be located. Principal destruction effort should be at the transmitter station because it is here that most of the essential equipment is maintained, and also where the detail would have less difficulty in approaching and completing its mission.

8. Fig. 3 shows the interior of a typical transmitter station. Behind the panel boards are located the main vacuum tube and wire system of the station, and at the desk in the center is contained the transmitting operating controls. This room will be in the transmitter station, which normally will be located underneath, or in the immediate vicinity of, the aerial towers.

Fig. 3. Control room of transmitter station

9. The broadcasts are transmitted from the broadcasting station to the transmitter station by a special telephone cable installed especially for that purpose. This cable may be strung on poles but on modern installations will be found underground, usually in the telephone cable vaults. The cable is almost certain to be buried at the point of entry into the transmitter station and for several hundred yards therefrom. Access to the cable can be gained, however, by manhole outside the transmitter station, or through a vault door which will be found inside.

10. After this cable first enters the transmitter station, it will look something like the illustration in Fig. 4, with many wires leading through an

Fig. 4. Wires in cable way of station floor

accessible cableway. These cables should be severed, and if possible sections thereof carried away and disposed of at some other point. The voltage in these wires is very small and should offer no danger to the personnel. However, as is true in the case of all wires in which the electrical current is unknown, severance should be made in a manner in accordance with all possible safety.

11. The telephone cable is normally a substantial lead covered conduit with many small wires contained inside. At the manhole section it would be advisable to puncture this lead cover and force water into the telephone wires. This will short all wires and spread in both directions from the point of rupture. Acid may be also used for this purpose and its penetrating effect will be somewhat greater than water.

12. Small nails can be driven into the telephone cable at isolated spots, and if finishing nails are used they will be very difficult to locate. The nail will short all wires with which it comes in contact and the repair thereof becomes a major operation. In this manner alone the communication facilities of a station may be completely suspended for a period of several weeks. The more extensive the area along the cable which is damaged in this manner, the greater length of time, of course, will be required to complete repairs.

13. Broadcasting may be done from either the principal broadcasting station in the metropolitan area, or the transmitter station in the suburban

district, as there will usually be found a low powered transmitter available in the broadcasting station for use in the event of trouble along the telephone line, or at the principal transmitter. This low powered unit in the broadcasting station is usually limited in distance, but if complete destruction of radio communication is desired, plans must be made to destroy this unit also.

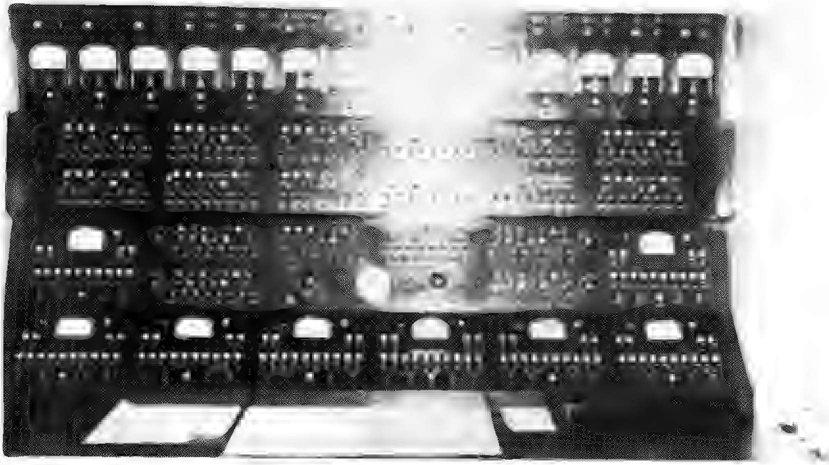


Fig. 5. Radio control panel

14. Many types of control panels will be found, both in the broadcasting and the transmitter station, and consideration should be given to their destruction. It is pointed out, however, that they are not nearly so important as

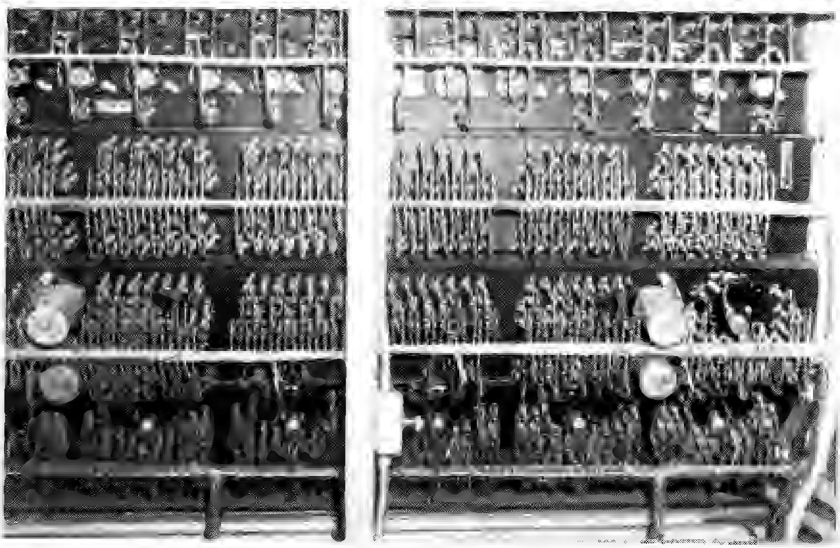


Fig. 6. Wiring in rear of control board in Fig 5

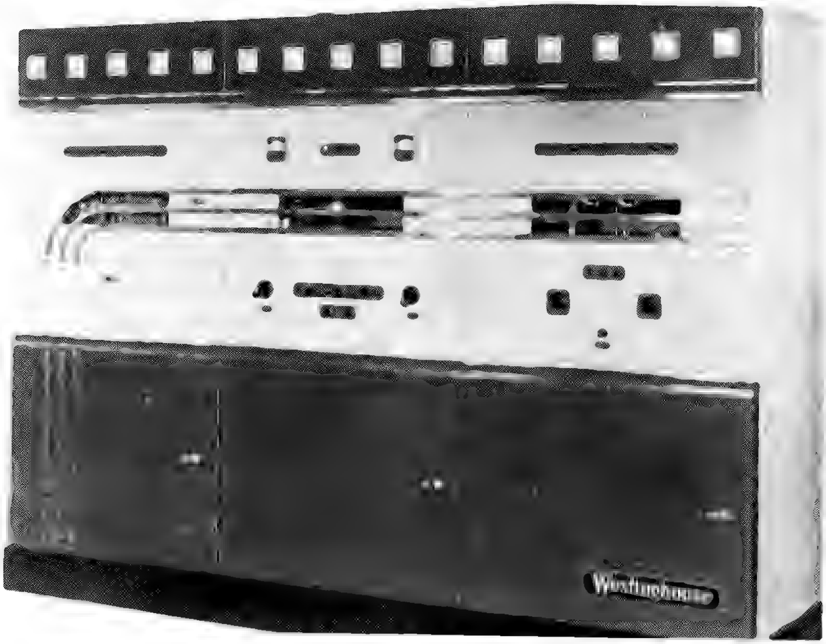


Fig. 7. Cabinet type installation (5KW)

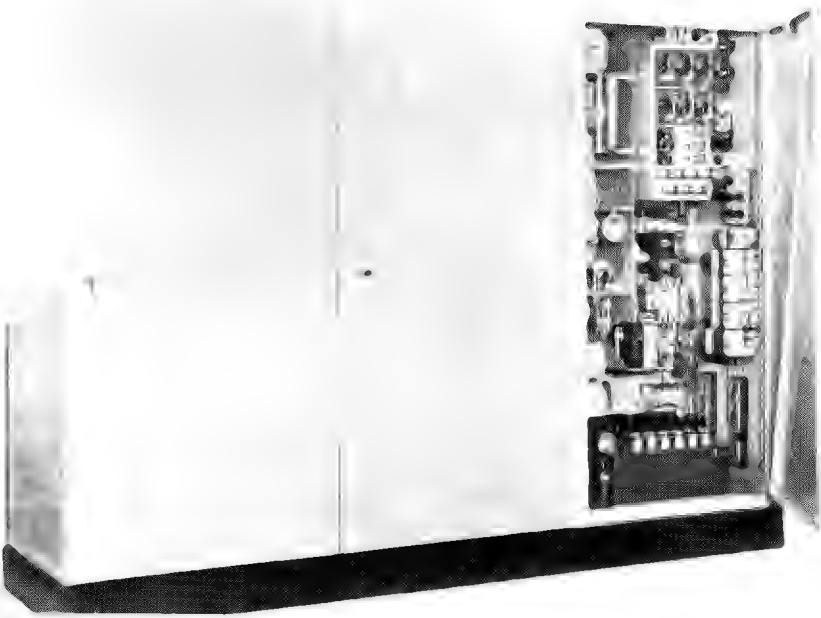


Fig. 8. Rear of Figs. 7 and 9 showing exciter cubicle open

other units discussed herein, as temporary wiring could be completed within a few days time, that would work satisfactorily, in the event the regular panels were demolished. Should the detail contemplate the destruction of these panels, it is advisable to do all of this work in the rear, as shown in Fig. 6 rather than on the face (Fig. 5) as a great deal more effective destruction could be accomplished at this point.

15. If a solution of the battery acid were splashed on the wires shown in Fig. 6, rather than on the face of the panel (Fig. 5), a great deal more effective destruction would be caused, or if a fire extinguisher were emptied into the wires, it would require days to put the plant back into operation.

16. Fig. 7 shows the type of equipment used in many modern radio stations. This is a small unit with the control panel shown in Fig. 9, and a portion of the wiring exposed through the opening of one of the back panels in Fig. 8. These cabinets are invariably locked and unless the keys are readily available the locks should be broken to gain access. Destruction efforts should normally be from the rear as the wiring and tubes are more accessible from this point.

17. Where high voltages are used, it is common practice to cause the opening of a door into transmitting apparatus to disconnect the plate circuit. The detail can remember, but not depend upon this device, however, and should therefore, be especially careful in approaching or entering these areas.

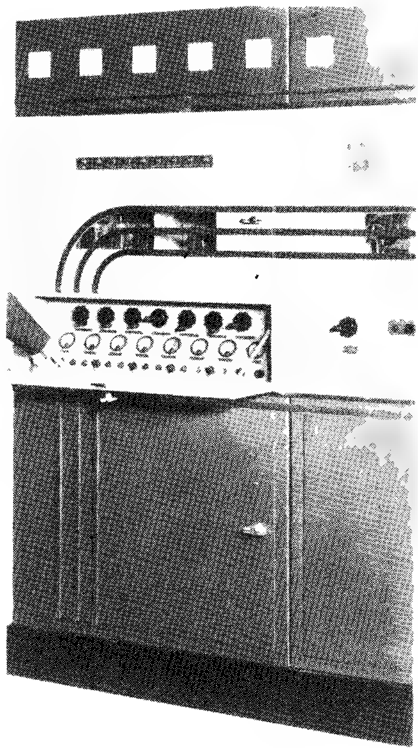


Fig. 9. Drop panel control board

18. Amplifiers are one of the most important units of a transmitting station, as without them it is impossible to transmit sufficient signal strength to be of value. In Figs. 10, 11, & 12 will be seen various portions of a typical amplifier unit, and in Fig. 11 can be seen the wire gate, from the inside, which is normally always locked, and which upon opening disconnects the plate circuit.

19. In a large station it may be difficult to destroy all of the amplifiers beyond usability, due to the possibility of interchangeability of a great many parts. Tubes, however, are one of the necessary component parts of the amplifier and these are quite easily destroyed.

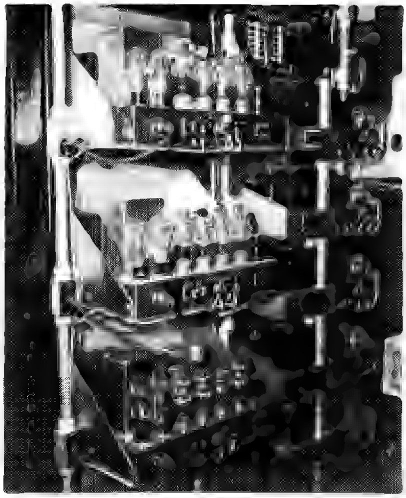


Fig. 10. Amplifier panel section

20. Vacuum tubes are necessary to the operation of all units of a broadcasting system, as in addition to the amplifier, the transmitter and receiver also employ tubes of various types and sizes. These may be destroyed in several ways; glass tubes, by merely breaking the glass, although as will be covered elsewhere, particular care must be exercised in how this is done on some tubes, in order to avoid serious injury from flying glass to the person doing the work.

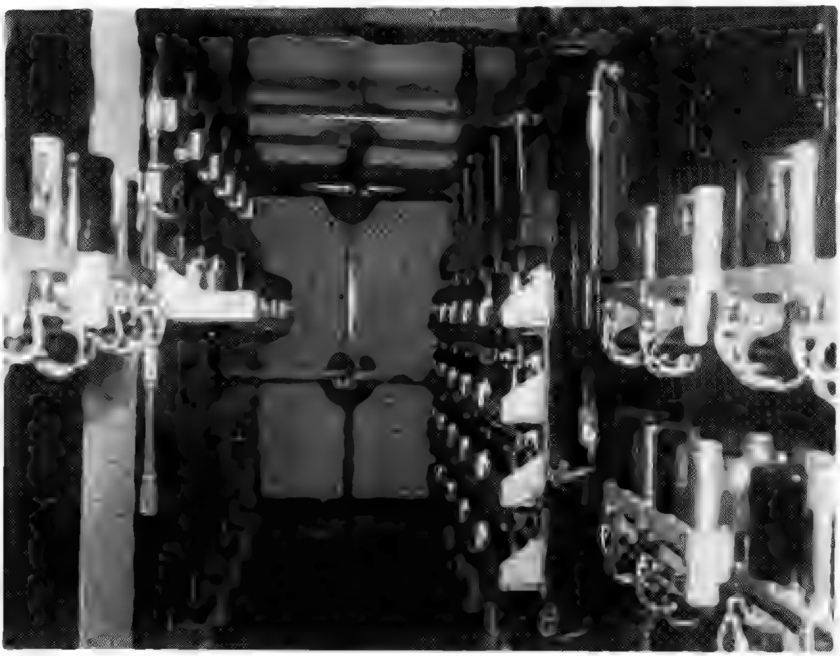


Fig. 11. Amplifier panels

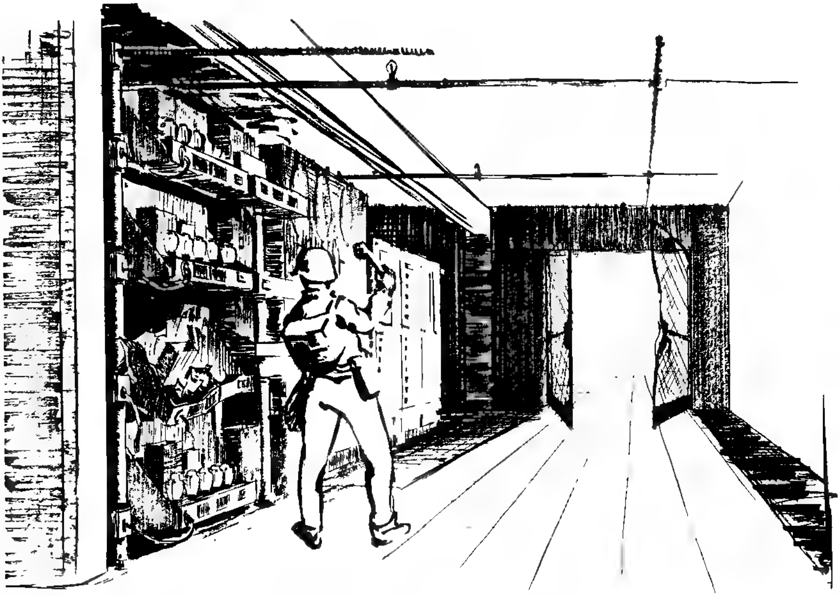


Fig. (b) The amplifier and transmitter panels should be destroyed

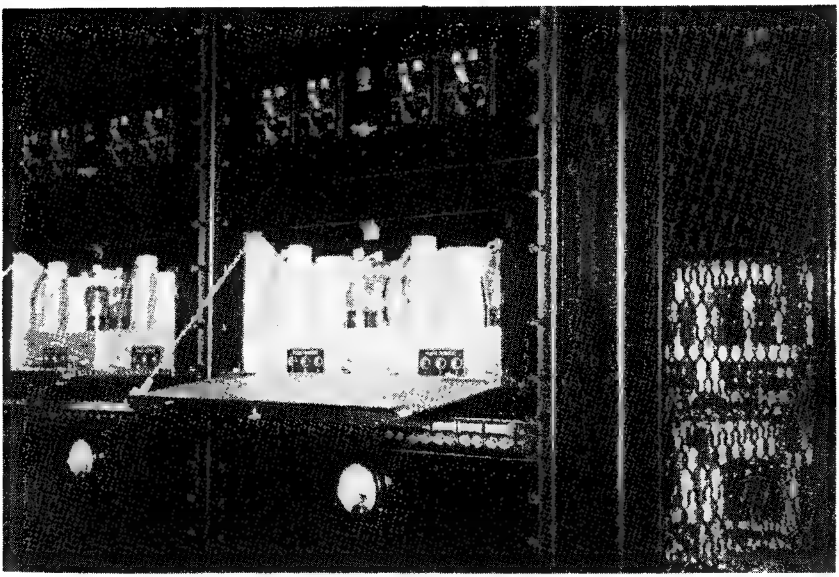


Fig 12. Amplifier panels

21. Fig. 13 which is another portion of the transmitter shows both glass and metal tubes, the metal being the black tubes on the right of each unit. These may be destroyed by sharp blows from a pick handle or similar heavy wooden club.

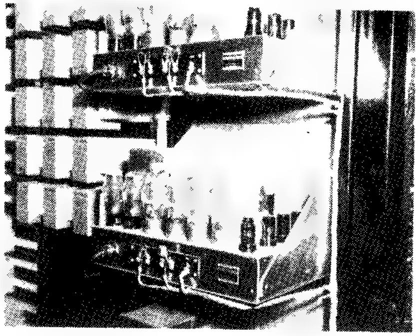


Fig. 13. Transmitter panels showing glass and metal tubes

22. There is little inside of a transmitter station to burn, except the rubber and other insulation material of the wire, but if a fire could be started from some combustible materials, such as fuel or lubricating oil from the stand-by engine. in the transmitter or amplifier sections, the heat would be sufficient. probably, to completely destroy all tubes and wiring.

23. Ordinarily the smaller tubes may be removed while the station is in operation, or the power on, without personal danger, although this is not true in the transmitter units employing high plate voltages. This information may be of value to a detail intent upon removing and returning with a supply of vacuum tubes to their own lines, for use in captured enemy equipment.

24. The supply room of the transmitter station should be entered and the supply of tubes, such as those shown in Fig. 14, or other important replacement equipment therein, destroyed or removed. Usually each transmitter station carries a sufficient replacement supply of all tubes to keep the station in operation, should the majority of those in service go out of action for any reason.

Fig. 14. Reserve tubes in supply room

25. Fig. 15 shows an assortment of various tubes which are in current use, from one of the largest, in a medium size station, to the smallest. Some of these, like the large one shown in Fig. 15, as well as many others, are cooled with a circulating water system. This system is a simple, electrically operated pump and distilled water storage tank, but is very essential to the tubes employing high voltages. If the pumps were destroyed or stopped and the current continued through the tubes, they would generate sufficient heat within a few minutes to destroy themselves.

Fig. 15. Vacuum tubes

26. Another type of tube which will probably be encountered in the larger stations is that known as the Cathode Ray tube, shown in Fig. 16. While not important to the ordinary signal transmission system, this tube should be destroyed, but great care should be used in its destruction. The tube will burst with considerable violence and throw glass and metal parts over a wide area. It should be destroyed by placing it on a ledge or high shelf, and pulling it off with a line, by a person in a protected position. The tube is used in television and is discussed here that its inherent danger

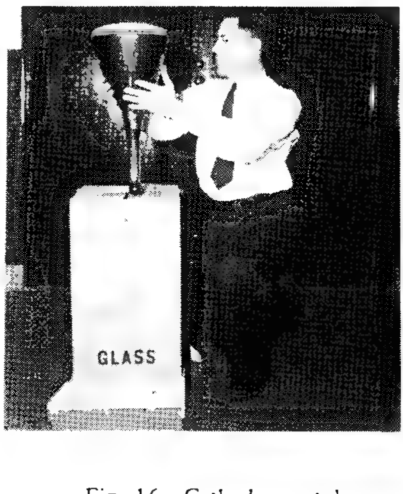


Fig. 16. Cathode ray tube

may be known to the detail, who would probably otherwise destroy it without taking proper safety precautions.

27. The care exercised in the Cathode Ray tube must also be observed when destroying all tubes in operation, that employ high voltages. While the size of the tube normally indicates its relative voltage, this may not be relied upon. Small tubes of obviously special build, and glowing with a blue haze should be destroyed with care, as they will burst with great force and throw flying glass a considerable distance.

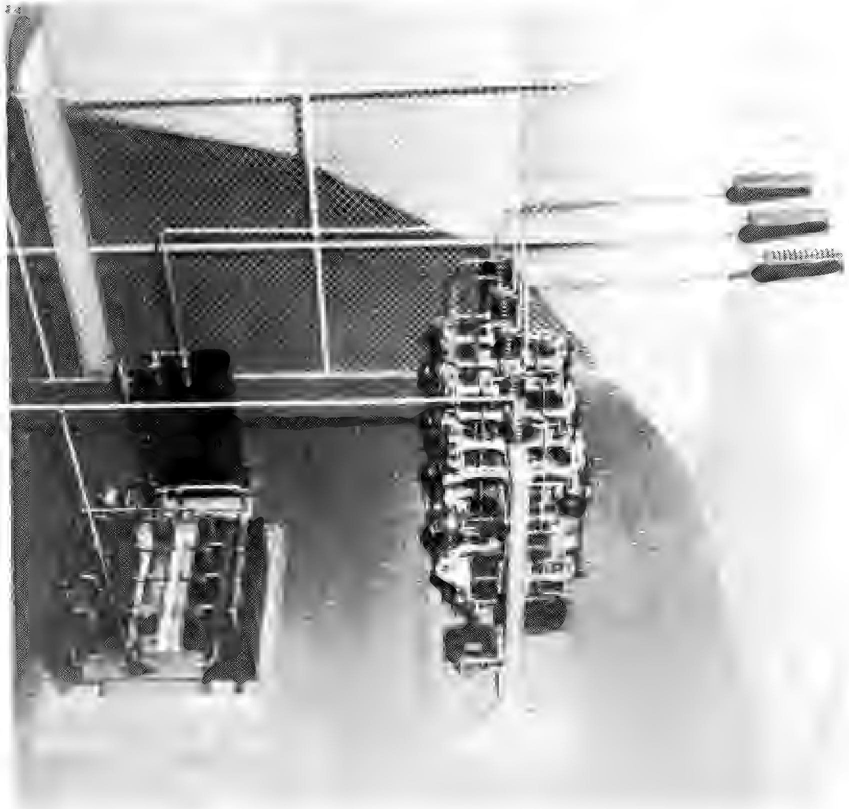


Fig. 17. Rectifier unit

28. Another very important and easily damaged unit is known as a rectifier system. Usually one of these will be contained in both the broadcast and the transmitter stations. Destroying or damaging this unit will require at least a week to install a new one providing it is available; if not, as much as a month might be required to rebuild or replace the one damaged.

29. A typical unit is shown in Fig. 17, and it will normally be found in the same room with the transformers, which, as stated before, will usually be on a sub-floor of the transmitter station. The rectifier can be easily identified as it will be similar in appearance to the one shown in Fig. 17, having two rows of large glass enveloped tubes seated in parallel rows, and mounted on a metal frame either enclosed or open. The tubes are about 16″ tall, and 6″ in diameter at the bulge. If the tubes are in operation they will glow with a distinct blue haze inside the glass envelope. These should be destroyed from a distance, preferably by small arms fire, as they are dangerous while in operation.

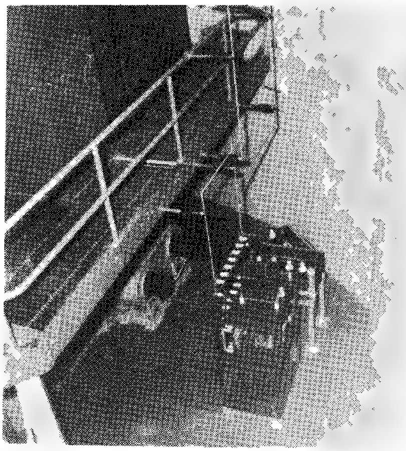


Fig. 18. Antenna lead-in (inside)

30. At the point where the antenna leads enter the transmitter building may be found a huge coil connected to the antenna system. This is known as the helix room, and while not particularly important to the transmitting system, may be very dangerous to the destruction detail, as it carries high voltages in exposed form. This unit should be avoided.


Fig. 19. Antenna lead-in (outside)

31. The lead-in arrangement of the antenna is shown in Figs. 18 inside, and 19 outside. Little good would be accomplished by destroying this lead-in arrangement either outside or inside and, therefore, it should be eliminated from consideration, unless complete destruction is desired.

32. The antennae are constructed in a number of different ways. They may be supported by a single tower, as shown in Fig. 20, or by two or more towers, sometimes arranged in line or at various angles to each other—Fig. 21. These towers should be fallen just prior to leaving the station, and after the work of interior destruction has been completed. On towers that are well-guyed, it is of course necessary

to sever the guy wires on the side opposite to the desired direction of fall, before severing the mast at the base. To fall a tower, the legs, if more than one, should be severed in the opposite direction of desired fall, and if possible some strain placed on the guy wires in the falling direction. The tower or towers should be toppled over the transmitter station, or across the high voltage transmission line through which the station received its power.

33. Towers that are supported erect by their foundations, and are not guyed, will fall in the direction of the severed legs. Always cut out two or three foot sections of the steel legs, above the insulators, and below the first trusses.

Fig. 20. Single mast antenna tower showing base construction

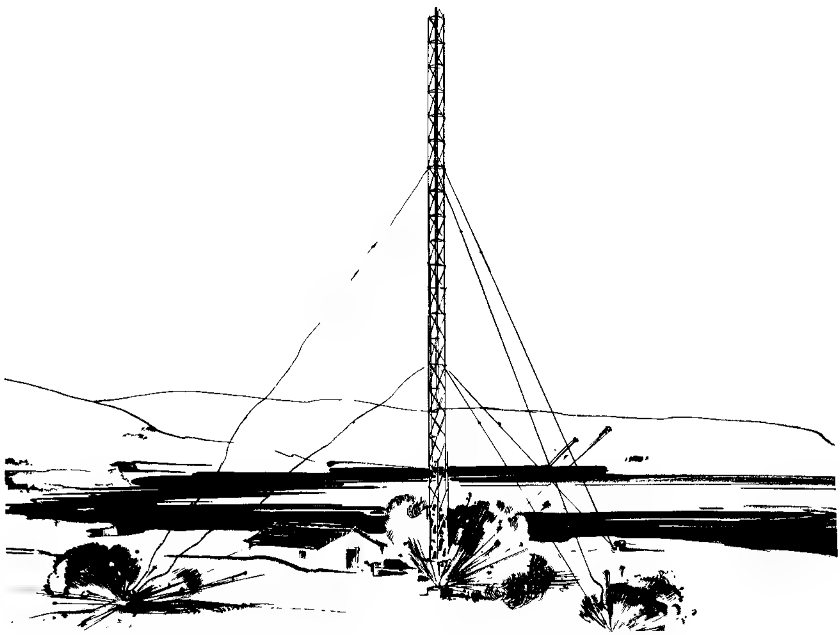


Fig. (c) Transmitting station with twin towers at Osaka, Japan

Fig. 21. Self supporting radio towers

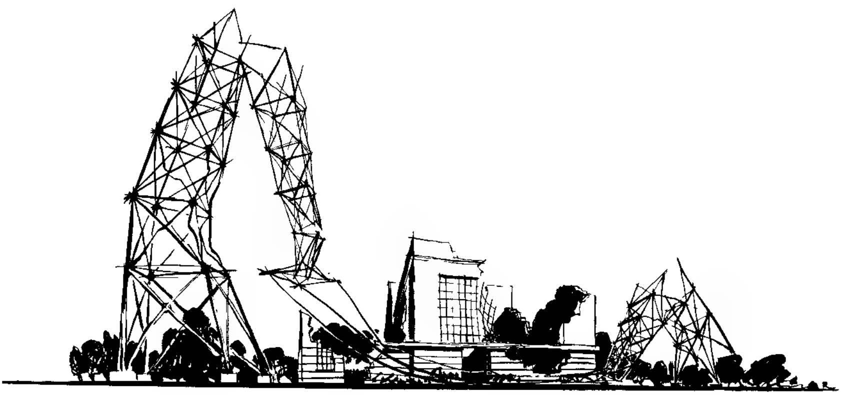


Fig. (d) Towers should be felled across transmitter station

TELEPHONE COMMUNICATION

1. The telephone is one of the vital links of a communication system, but due to its grid type of network, it becomes almost impossible to isolate an area from outside telephone communication, within a limited period of time.

2. Telephone service the world over is operated on the basis of a central station, usually located in or close to the center of a congested metropolitan district. This office ordinarily houses the general business and engineering offices, and contains a central or principal exchange through which most long distance calls are serviced. These buildings are difficult to recognize in view of their general office building appearance. Ordinarily no stacks are visible as their power requirements are limited, and usually contained within the building, as described elsewhere.

Fig. (a) Modern telephone headquarters and central exchange in Tokio, Japan

3. The critical points of such an establishment are usually contained on the second, third or fourth floors of a multi-storied structure. The first floor being given to offices open to the accommdation of the public, and the upper floors of the structure are usually devoted to the general engineering offices of the company.

4. From a standpoint of aerial bombardment, it is difficult to destroy or impair the efficiency of a central exchange. It would be practically impossible to penetrate the upper floors, which normally contain no material of importance, to reach the exchange itself on the lower floors. If a build-

ing is definitely identified as a telephone exchange and becomes the target of an aerial attack, it is better to direct the bomb attack on the area immediately in front of the building, usually in the street where one or more manhole covers will be visible at low altitudes. These manholes permit the passage of men into the telephone cable areaways below, for service and repair. These subterranean areas, normally not to exceed six to eight feet in depth immediately outside an exchange, carry all the telephone cables in service in that exchange, and therefore represent a very vulnerable area.

5. For destruction by surface units, it is recommended that demolition groups enter these manholes and sever the very prominent lead cables therein. These cables contain in lead housings thousands of individually small wires that are subject to easy destruction. Normally two one-half pound blocks of TNT (or possibly four) placed around a cable will sever it very successfully. If the area-way is sufficiently large, two charges should be placed fifteen or twenty feet from each other, so that the cable could be severed in two places, and then an effort should be made to dispose of the severed section where it cannot be found and re-utilized.

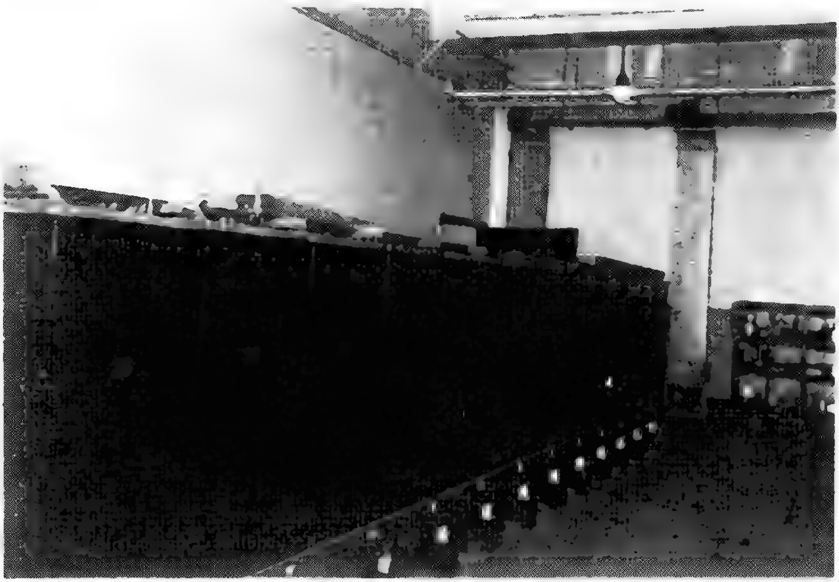


Fig. 1. Wood battery cases

6. If time permits the drainage system of the manhole could be plugged and the manhole then flooded with city water, usually nearby, until the ends of the severed cables are submerged. Through this action the water will penetrate for several hundred feet inside the length of the lead covered cable and ruin it completely. This method of telephone destruction would

probably put the particular exchange out of commission for a period of one to three or four months, due to the tremendous amount of rewiring which would have to be done.

7. In a large metropolitan area there will normally be, in addition to the central exchange, one or more others, located in the center of business subsections, or other populated local areas. These exchanges are extremely vulnerable due to the fact that the building in which they are located usually houses very little other than the actual exchange equipment.

8. In some Asiatic countries telephone exchanges still carry their wires on an overhead system and can, therefore, be easily distinguished. On the other hand, an attempt has been made to place most systems underground in the more important countries; and in Japan in particular, installations are almost entirely underground, and are as modern as will be found any place else in the world.

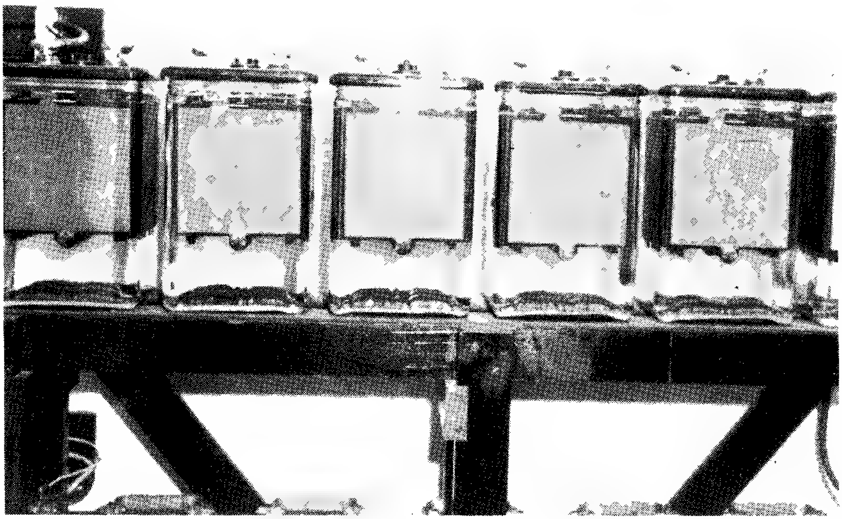


Fig. 2. Glass battery jars

9. Fig. (a) is a picture of a modern telephone installation in Tokio, indicating the character and location of the building, as well as its modern architecture.

10. A modern telephone exchange operates to a large extent on an automatic basis, through equipment called automatic relays and selector units. Power is almost universally supplied through a storage battery system, and. therefore, the demolition crew are safe from high voltages, as it is rare that more than fifty volts will be encountered.

11. Fig. 1 shows a typical installation of the older-fashioned, large wooden case, lead-lined batteries that are in use in many Asiatic countries. These batteries are very easily destroyed, requiring nothing more than puncturing the case, which can be done by small arms fire, and will cause the acid to be drained through the bullet holes. This will temporarily, but not permanently, put the power system out of operation. Before puncturing the cells, the terminal strips located at the top of the batteries should be destroyed by wooden-handled sledges or hammers. It is pointed out that the acid contained in these batteries is very dangerous to the human being, as well as to exposed surfaces subject to corrosion, and care should be taken to avoid contact with the acid, while at the same time, saving it for other destructive uses as explained later herein.

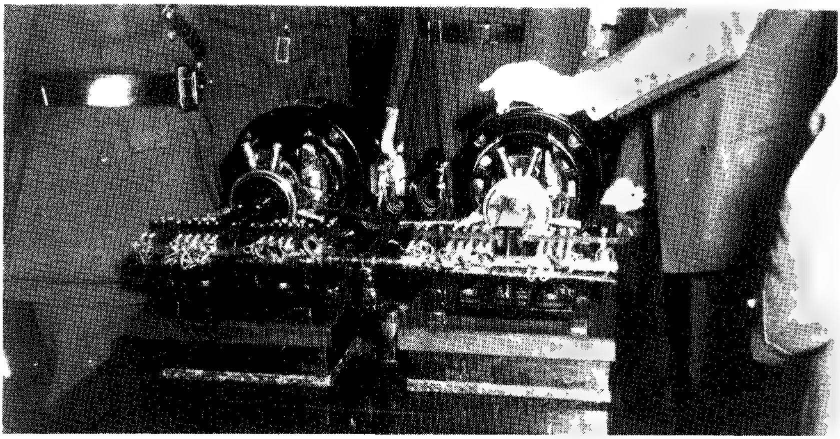


Fig. 3. Small battery recharger

12. The battery system may be composed of a number of glass jars, (Fig. 2), sometimes as large as five or six feet in height, and these, of course, are subject to the same destructive forces as outlined above for the wooden cases, although the jars themselves may be more completely demolished by small arms fire or impact.

13. Each set of batteries contains a recharge system composed of one or more chargers. Figs. 3 and 4 show some of the various types in use as installed; and it is pointed out that it is quite important to destroy these machines at the same time the destruction of the batteries is completed. Thermite can be used to fuse one or more bearing points on each machine, and a burst of small arms fire into the generator windings will put this unit out of commission until it can be replaced, which normally would require at least ten days, if replacement units were available.

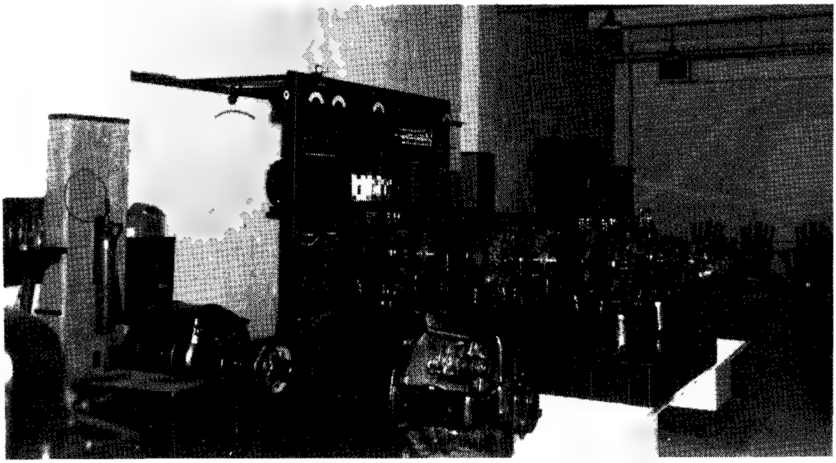


Fig. 4. Battery rechargers

14. Telephone exchanges usually, as is the case with other industries and services requiring power, always maintain a stand-by power unit, which can be put into operation instantly upon the failure of the primary power source. Normally this consists of a Diesel or gas-driven generator, similar to the one shown in Fig. 5, and if time permits this unit should also be destroyed. These units are normally self-contained and quickly replaceable, and the destruction thereof would not be an important part of the mission.

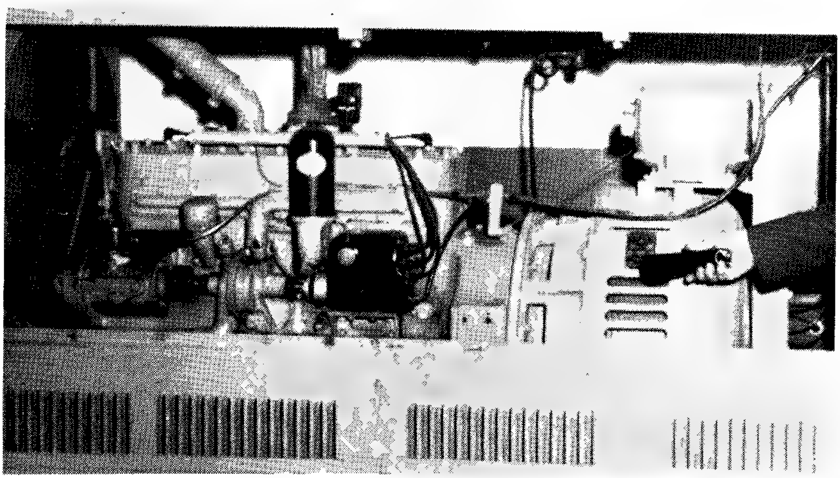


Fig. 5. Standby power unit

15. Fig. 6 shows a cable vault. This is normally located in the first or second sub-surface floor, and represents the combining of all of the wires entering and leaving the exchange, at the point where they join the outside underground system. These are especially vulnerable and should be the object of the first demolition effort upon entering an exchange. As pointed out previously herein, these cables are easily severed by a necklace of one-half pound TNT blocks, and in order to effectively demolish the circuits each of the pairs of cables must be severed. If a short section of this cable were cut and carried away it would take thirty to sixty days to put the exchange back into operation.

Fig. 6.
Underground cable vault in exchange

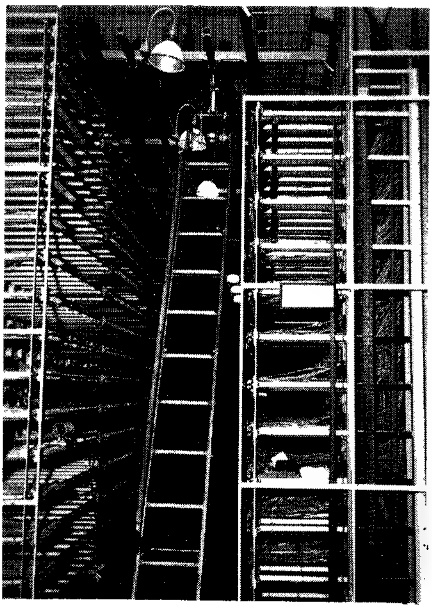


Fig. 7.
Automatic relay and selector switch wiring

16. Figs. 7 and 8 show portions of the automatic relay and selector switch room and its intricate wire patterns.

17. Fig. 9 shows the maze of terminal strips, and it is pointed out that this is one of the most vulnerable portions of a telephone system. The wires at this point are extremely delicate, and rupture at the slightest disturbance. A stream of water from an ordinary hose should be played upon the entire area, as it would thus be put out of commission for an indefinite period of time. Water on these terminals is sufficiently corrosive to immediately sever the wires. If water is not available, a fire extinguisher should be used and its contents sprayed upon this area. If time

Fig. 8. Selector switch wiring

permits the acid from the destroyed batteries could be utilized for this purpose, although it is repeated that care must be exercised in the handling of this fluid. A blow torch or flame thrower could effectively destroy an exchange system within a period of two or three minutes, to such an extent that it would require that many months to place it back in operation.

18. Figs. 10 and 11 show the intricate detail of selector switches and automatic relays, all of which are sensitive to shock, liquids and heat, and which can be effectively put out of commission in a very short period of time by any of these means of violence.

19. Those engaged upon a mission of destruction of this character are again reminded, that despite the im-

Fig. 9.
Terminal strips

pressive and intricate wiring systems employed, the voltages are sufficiently low to permit any type of destruction activities, without danger from electrical shock to those engaged in the task. Discretion, however, dictates that wooden-handled hammers or clubs should be used.

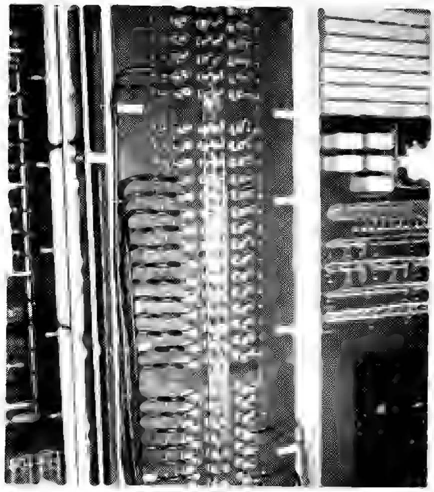


Fig. 10. Selector switches

20. In general it may be said, that in order to completely destroy, or put out of operation, the telephone communication system of a given area, it is not only necessary to destroy the central exchange, but all others operating thereunder. However, if time is limited, the first destructive effort should always be against the central exchange. This will usually destroy telephone communication with other cities or areas, whereas, the destruction of a local exchange merely deprives that small section of telephone communication, which, in most cases, would not be considered vital for any military purpose. It is evident of course that substations serving industrial areas should take precedence over residential stations, after destruction of the central station, in the overall destruction plan.

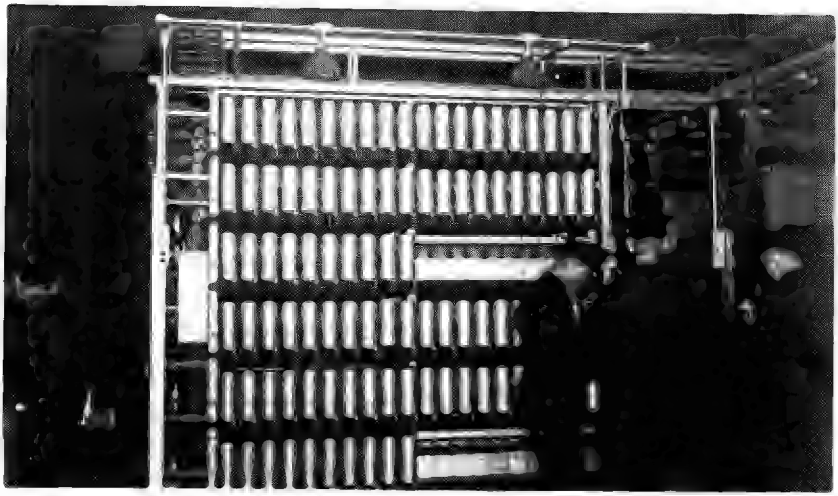


Fig. 11. Automatic relays

SHIPBUILDING

1. The building of ships, both for war and commerce, is an extremely important activity to any nation engaged in war, and the subject of destruction of these industries is entitled to a substantial amount of attention.

2. Shipyards for the construction of large ocean-going vessels, and particularly war ships above the size of destroyers, are usually located on salt water and, therefore, become somewhat more accessible to destructive effort by surface raids than industries located further inland.

3. The destruction of shipyards requires large scale demolition activities, due to the fact that there are few small machines or installations, vital to its operation. Most of the important equipment is massive and usually constructed of fire resistant concrete or steel.

Fig. (a) A shipbuilding plant at Nagasaki, Japan

4. If the ways are constructed of wood, as is the case in most Asiatic yards, they may be destroyed by fire, providing time permits and other conditions are favorable. Strong winds are very desirable, and fuel oil or other combustible products should be available for liberal application to various sections of the framework.

5. Should destruction of this nature be attempted, it is advisable to first include those ways in which ships are in the process of construction, in the fire setting plan. The destruction of these ways by fire would un

Fig. 1. Shipbuilding and repair shop

doubtedly generate sufficient heat to twist the steel hulls of the vessel, and to burn out the supports, allowing the ships to topple on their sides. There is normally sufficient wooden frame superstructure in a ship's ways, if properly ignited and assisted with combustible materials, to so damage a ship held therein, as to require its complete rebuilding.

6. Should the construction of the ways be such that burning is impractical, a number of blocking braces on one side should be fired or demolished, thereby allowing the ships to topple on its side, where it would block the ways until completely cut apart.

7. Fig. 1 shows a typical medium-size shipyard engaged principally at the time of this photo in the repair and rebuilding of ships. No ships are in the process of construction in the three ways of the left foreground, though a number of vessels are being repaired in the area immediately beyond.

Fig. 2. Overhead crane

8. Probably the most vulnerable of this, or any other shipyard, is the large crane indicated by (T-1). This crane is used for the purpose of moving the large steel plates, stanchions, etc., from the storage yard to and from the bending and cutting shops, and to the smaller cranes, of which there are two in the figure, indicated by (T-2).

9. These smaller, mobile cranes actually deliver the heavy plates to the construction or repair ways where it is then handled by the six construction cranes indicated in the figure by (T-3).

10. The large tripod crane, indicated by (T-4), is designed for the purpose of installing the heavier types of equipment such as boilers, turbines, etc., and is one of the targets of first importance. With the exception of

the two mobile cranes shown, the others are especially made and all construction work in the yards would necessarily cease until these were rebuilt, which might require a period of thirty to sixty days.

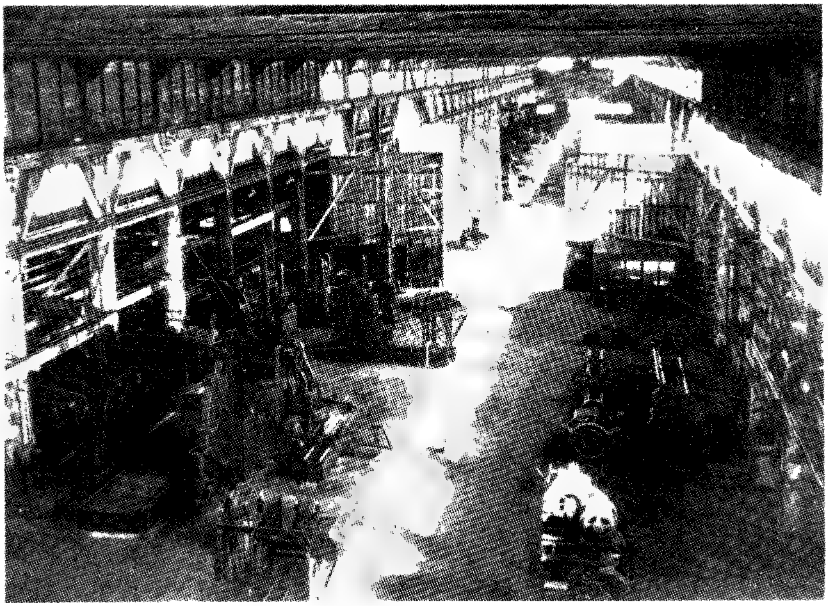


Fig. 3. General view of machine shop

11. The machine, forge and cutting shops, indicated by (T-5-6-7) respectively, are considered a great deal more important than the pattern and mold loft shown as T-8. The latter building is normally the largest and most imposing in a shipyard area, but with the exception of blue prints and patterns, there is little contained therein important in the destruction of the plant.

12. In destroying cranes effort should be first made to use the power of the cranes themselves toward their self-destruction. They can be hooked together to pull each other over, can be used to tear up construction work, pull up crane and railroad switches, and carry important heavy machinery to the dock and drop it into the water. If time doesn't allow this, then such heavy equipment as can be torn loose should be hoisted as high as possible and suddenly dropped. Before leaving the area all cranes should be toppled off the dock into the water, or in some effective manner destroyed. A crane will easily topple itself into the water by hooking the mainline cable to a bitt on an opposite wharf, and setting the low gear of the winch in motion.

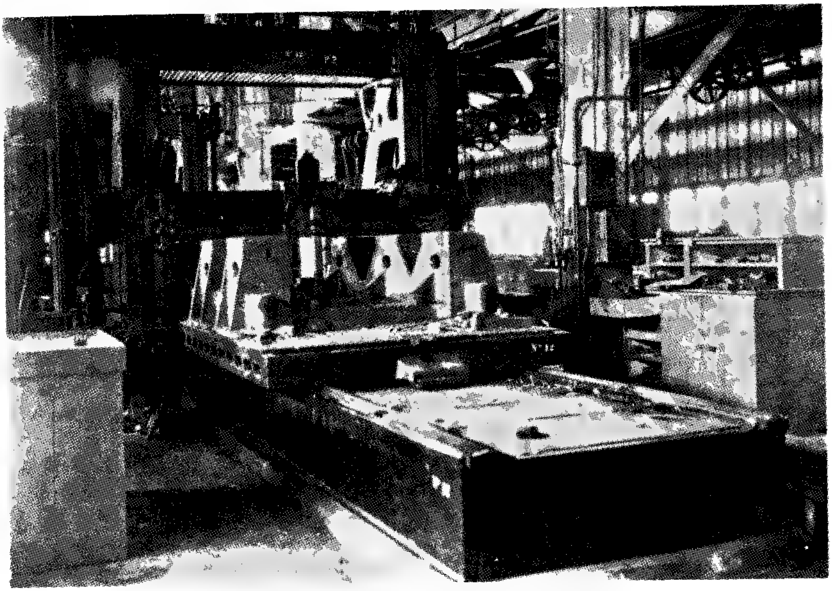


Fig. 4. Large steel planer

13. In the case of some larger type cranes, where the tracks do not approach the waterway, an effective job of destruction could be accomplished by using the power of the crane to suspend a heavy object on the arm, and then with explosives blow out or cut one or two of the principal supporting columns.

14. Tall and heavy capacity cranes of the stationery type should be wrecked in such a manner as to cause the crane in falling to fall over the most important object nearby. The force of the falling crane would practically destroy any building, or the superstructure of any ship beneath. This type of crane is well-balanced, and usually will topple only if a strain is placed from the top of the tower, by anchoring the mainline in the direction in which it is to fall, and tightening just before setting off the charge.

15. The detail should make certain that on those cranes not totally destroyed, at least the identical parts on each should be damaged so that replacement by exchange would be impossible. The winch of the crane is the most important part and is easily damaged with a small amount of explosives, thermite, or heavy metal objects thrown into moving gears.

16. Most shipyards, especially repair yards, contain one or more floating or excavated dry docks. In Fig. 1 will be seen three of the floating type, two carrying vessels and one empty. These are usually made of wood, though in some cases, steel is employed. The wooden ones normally can-

not be sunk due to the bouyancy of the material, as well as a number of air tight tanks. Fire should be employed by the surface detail to destroy these units, as a very effective job can be done in this manner, if various combustible materials such as oils or gasoline are first liberally poured over the area.

Fig. (b) The large cranes should be fallen across critical objects

17. Floating dry docks constructed of steel may be sunk by opening the sea-cocks, which will be found inside the double bottom, and which require

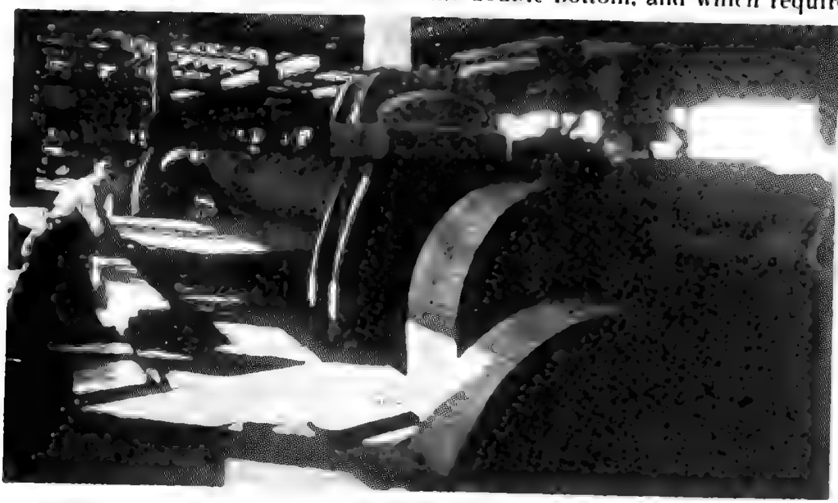


Fig. 5. Heavy steel rolls

entrance through a manhole, found in the deck of each water-tight section; or the valves controlling the water flow in and out may be blown or blocked open.

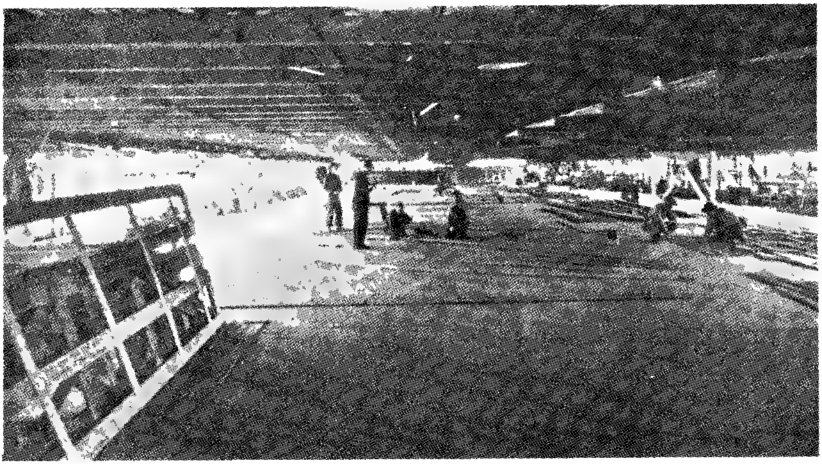


Fig. 6. Mould loft

18. If time is limited the most effective method of damaging one of these units is by destroying the pumps, located in the engine room thereof. These pumps flood the various compartments when the dock is submerged to receive a ship, and then pump the water out to elevate the unit.

19. Considerable damage would be occasioned by a direct hit on either a filled or empty floating dry dock by an aerial bomb, but on an empty dock, unless a number of compartments were breached, it is doubtful if sinking would occur. Where a choice exists the filled dry dock should be attacked first, as it is more easily sunk due to the weight carried. Sinking would also probably cause the suspended ship to sink, by submerging same while plates have been removed for repair. These docks are built of double compartment construction, and therefore delayed action bombs should always be used when these are the target, in an effort to secure demolition in the water below the bottom plates, where explosion would breach or spring a vulnerable area.

20. Another type of dry dock usually in navy yards and the larger shipyards, is the excavated or graving type. Fig. 8 illustrates two docks of this type together with the cassion gates and the powerhouse. The critical area of these installations is, first, the cassion gates and, second, the powerhouse and pumps. As an aerial target the cassion should be selected first and the aiming point would be that indicated by the arrow and (T-1). An attempt should be made to strike the water directly in front of either wing of the

cassion, and delayed action bombs should be used in order that sufficient water head would be present at the time of explosion to concentrate the force against the cassion hinge area.

21. It will be unlikely that the average surface detail would possess enough explosives to breach the cassion, therefore, attention should be centered on the pumps and power arrangement. The pumps will be found located underneath the powerhouse and somewhere near the cassions. These are usually of a centrifugal or reciprocating type and have enormous capacity. They are easily destroyed or damaged by the use of explosives or incendiaries on the critical parts, as has been shown in other chapters. The power source may be electricity from municipal high tension wires, or it may be generated by its own steam or Diesel electric system. This unit of power should, of course, be destroyed as has been explained elsewhere herein.

22. Ship building yards ordinarily have one large central tool house where the majority of the special tools are stored. For a complete job of destruction, access to this building should be gained and the obviously important tools therein wrecked under the hydraulic presses or thrown into the forge. A great many pneumatic tools, and power-driven equipment will be found, which should be battered with a sledge hammer or dropped into the water. Submersion for even a short time will probably completely ruin the equipment.

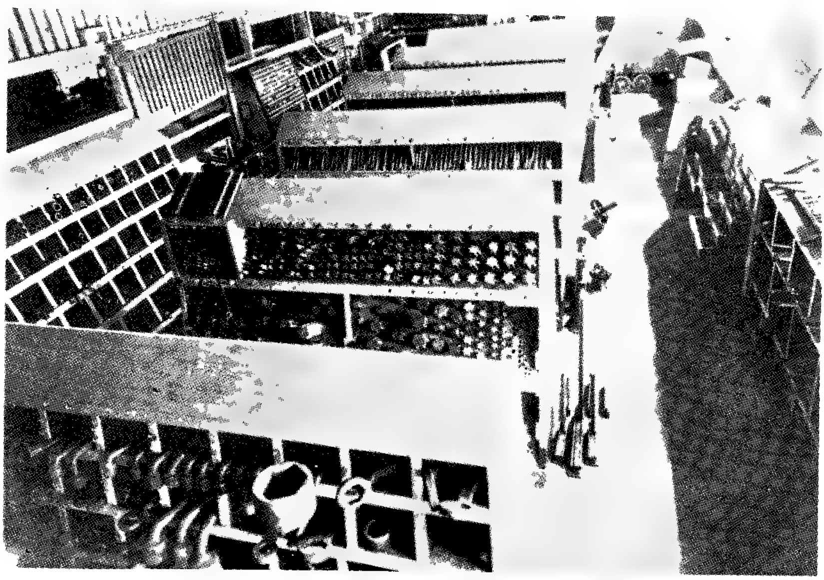


Fig. 7. Machine tool room

Fig. 8. Dry docks

23. The power plant and air compressor unit of a ship building yard are extremely important and if they were demolished, or even the critical equipment therein damaged, the yard would necessarily shut down until power could be brought in from outside sources, and portable air compressors obtained. In any event a delay of two or three weeks would certainly be encountered.

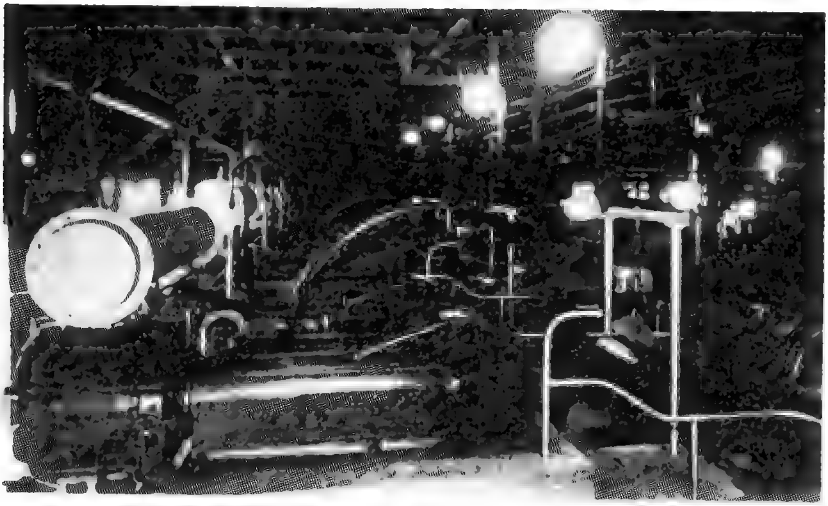


Fig. 9. Air compressors

24. In critical areas during wartime it is quite probable that portable electric generators, of sufficient capacity to handle any plant, could be quickly brought to the area in order to restore operation. These units are either mounted on truck or railway car depending upon the capacity thereof; or temporary power would be supplied over a hastily constructed line from some other nearby source. All transformers within the plant area should be destroyed in order to delay this emergency power supply as much as possible.

25. If time permits the large lathes which will be found in the shipyard machine shops should be damaged or destroyed. These are normally specially built and are used to turn propeller and rudder shafts. They could be easily ruined by a small amount of explosive or thermite, and the difficulty of replacing would be well worth the effort, as it would represent a serious loss to the yard.

26. While, with the exception of ways, docks and dry docks, a shipyard is not especially vulnerable to fire, consideration of destruction by this agent should certainly be a part of the general plan, as has been discussed previously in this chapter.

27. Around the ways will usually be found automatic sprinkler systems, and water under heavy pressure, for the purpose of fire prevention. The connections to the sprinkler system and the high pressure hydrants should be severed where they enter the area, and before the fires are started. These are easily found and quickly identified as they are of the normal gate valve handwheel type. The main service connection will usually be found in a manhole opening near the main entrance to the plant, or on the side nearest the city from which the supply comes.

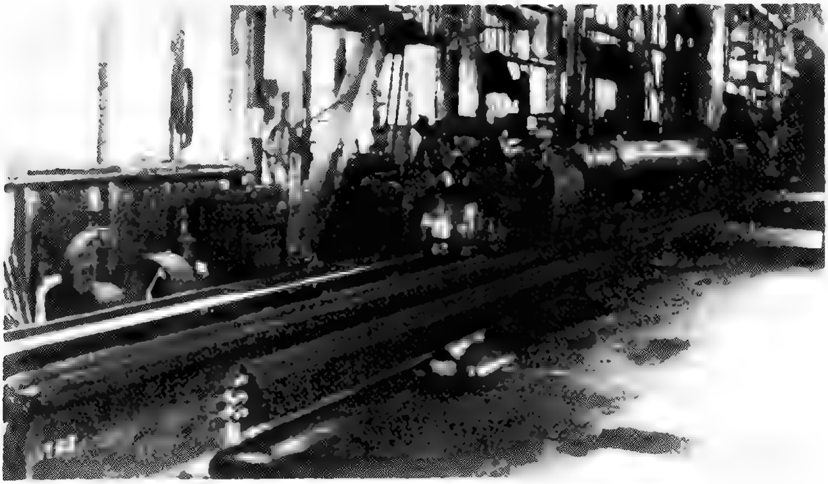


Fig. 10. 40 foot shaft lathe

28. Fig. 11 shows a yard employing the side launching method, with one ship in the ways and three at the fitting dock in various stages of completion. This yard is also engaged in the building of large barges of which several are visible in varying stages of construction.

29. In this yard, as all others, the most critical targets for first destruction effort are two large mobile cranes located along the ways, indicated by (T-1), and next is the floating crane, indicated by (T-2). The other installations of the yard are of the same relative importance as has been discussed elsewhere in this chapter, and may be destroyed or damaged by the same processes.

30. Attention should be given to the three ships in various stages of completion and outfitting, as well as the crane with which the work is being done. The ships at this stage are very vulnerable to attack as the water tight sections are accessible and easily breached or opened. Therefore, several demolition charges may be placed directly against the inside of the bottom

Fig. 11. Shipbuilding yard

and effectively breach the same. Here, as in the case of other charges, the explosive must be placed so that it is compressed as much as possible from above or from the sides, in order to gain its maximum force against the object to be breached.

31. Fig. 12 illustrates a small shipbuilding and repair yard where the RF is 1″=1667′.

Fig. 12. Shipbuilding yard; scale 1″=1667′

Fig. (c) Overhead cranes in a Kobe, Japan shipyard

HARBOR FACILITIES

1. There are only a few major items of importance to be considered in the plan of destruction of harbor facilities. These are particularly the loading docks and wharves, adjacent railroad lines, warehouses and cranes. However, the amount of damage which can be accomplished by either air or surface action, within a comparatively short period of time, justifies the serious consideration of this type of effort.

Fig. 1. Interior of dock warehouse

2. The railroad tracks, particularly the switch points and cross-overs, and the heavy capacity cranes, are subject to comparatively easy destruction with the use of explosives or incendiaries, while the warehouses and docks can best be destroyed by fire. In practically every port area will be found oil and gasoline loading docks or barges, and where the use of fire is contemplated as a means of destruction, these units should be struck first, in view of the very large and unmanageable fires they would normally create.

3. As in the case of ship building yards, the most important single units of machinery to be destroyed would be the large capacity cranes, and these should be destroyed in the manner which has been elsewhere described herein. Very few cranes will be found in a commercial harbor area, except those for the handling of particularly heavy pieces of cargo, as each ship carries its own loading and unloading gear. However, in navy yards many extremely large ones are an important part of the yard equipment. These big units should be singled out and destroyed if possible, as they are specially built and cannot be replaced except by rebuilding.

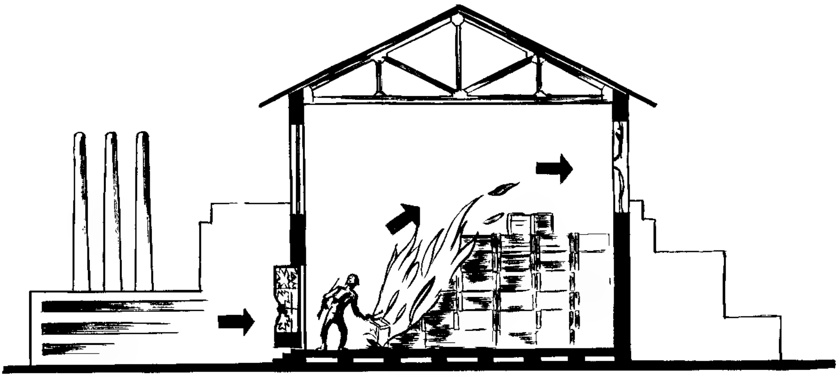


Fig. (a) Break openings in warehouse for efficient destruction by fire

4. The use of fire is probably the greatest agent of destruction that can be employed in a harbor area. Warehouses, such as shown in Fig. 1, usually contain many inflammable commodities, which may be very easily fired with incendiaries. In setting a fire in a warehouse, such as shown in Fig. 1, either to the building itself, or to the contents therein, it should be remembered that drafts must be provided, and that windows or ventilators high on the lee side should be opened, or preferably broken, and doors and windows on the low windward side should be sprung open in such a manner as to preclude their being shut.

5. While in the process of starting these fires, the automatic sprinkler system, which will usually be found in modern warehouses throughout the world, should be disconnected where the principal water lead comes into the warehouse area from the street. A gate shut off valve, such as shown in Fig. 2, will usually be located in a manhole immediately outside of the warehouse area, and the valve itself should be shut, and then demolished with a charge of explosives.

Fig. 2. Shutoff valve

6. A typical automatic sprinkler system is shown in Fig. 3, which will usually be located somewhere near the main entrance to the building. These sprinkler systems are electrically connected with fire or police department headquarters, and if stealth is one of the objects of the raid, the electrical connections should be severed before any action is taken to destroy the sprinkler system.

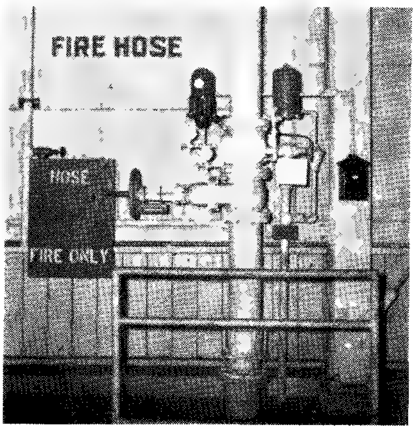


Fig. 3.
Automatic sprinkler control and alarm

7. After disconnecting the alarm system, the pipe should be severed with explosives at a point underneath the floor where it enters the building, in order that the flow of water, which is usually under heavy pressure in these pipes, is not directed into the area to be fired. Fig. 4 gives a closeup of the sprinkler control and warning notice, and a reading of the dial indicates that 75 pounds of pressure is maintained in the pipes. Very often, however, pressures up to 200 pounds in the sprinkler, or fire prevention system, may be found.

8. In connection with disrupting the fire fighting system, it is well to consider the immobilization of all fireboats before large fires in the harbor

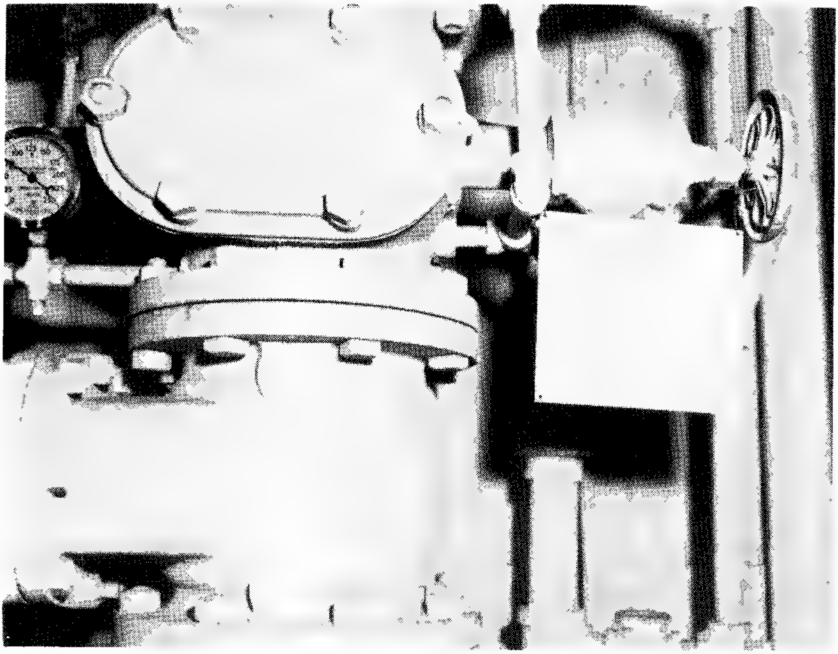


Fig. 4. Closeup of automatic sprinkler system

area are started. These stations are usually well-known, or are easily identified, and on the waterfront of a large metropolitan city there may be three or four of these principal stations, each with one or more fireboats. In an aerial bombing mission particular plans should be made to put these fireboats out of service before, or at the same time, the fires are started.

9. Wherever docks, wharves or warehouses are built on piling, as is usually the case in most Oriental countries, it will be found that these are either pressure creosoted or heavily covered with a creosote type paint. Such construction is especially vulnerable to fire, particularly if burning oil or gasoline can be ignited thereunder, or close by, so that it will flow with the moving tide or current underneath the warehouse area. Fig. 5 shows an example of typical pile construction, and some appreciation of the damage which could be wrought by fire can be gained therefrom, if a hot and prolonged petroleum fire could be started on the surface of the water.

10. Where the construction of this under floor surface is of reinforced concrete, such as shown in Fig. 6, the fire efforts should be directed toward the decking and interior of the warehouses entirely.

Fig. 5. Piling under dock

Fig. 6. Reinforced concrete piling

11. Wherever fires are set in the under floor area, it is advisable to have all hatches, of which many will be found on the warehouse floor, opened in order to provide draft, and entry of fire into the interior of the building.

Fig. (b) Important Japanese river-mouth port

HARBOR FACILITIES—AVIATION

12. From the standpoint of aerial bombardment, it is difficult to identify any particular target of a harbor area which could be considered more vulnerable than others, with the possible exception, however, that the order of importance of these targets, as indicated elsewhere herein, should be observed. If large fires are to be started, which is usually the mission of a harbor attack, effort should be made to destroy fireboats and such water reservoirs and pumping stations as may be located in the immediate vicinity. If oil tanks are located within an effective radius, these, of course, should be bombed in such a manner as to release, both the oil from the tank and the retaining dike yard, to the water if possible.

13. Fig. 7 shows a typical harbor area with a number of very important objectives therein. The tank yard at the head of the channel should be demolished first and the demolition bombs, as has been stated elsewhere, should be followed immediately, or accompanied by incendiaries.

14. The point of breaching of the tank yard is indicated by a circle. Here one hit would breach both the dike and a filled tank and permit the burning oil to reach the water, oil barge and docks. Tanks (b) and (c) would probably become ignited, and tanks (d) (e) (f) and (g) are only partially filled. The tank yard containing four tanks, and the one adjoining with eleven tanks, indicated by T-2, should be the target of second importance, as the presence of the dike around each indicates that they contain an inflammable liquid. Tanks in vulnerable areas do not always contain inflammable liquids, as in time of war these are very often pumped back into tanks in a better protected area, and the first tanks filled with water for fire protection.

15. In the illustration, however, the presence of a tanker at the dock indicates that the transfer of petroleum products is in process. The tanks on land are more easily breached and set afire than those on the ship, by aerial bombing, and the release of the oil from the tanks and dike would undoubtedly destroy the pier, and possibly the ship.

16. The large battery of 27 tanks in the right center of the picture would not normally present a target, in view of the fact that no retaining wall is

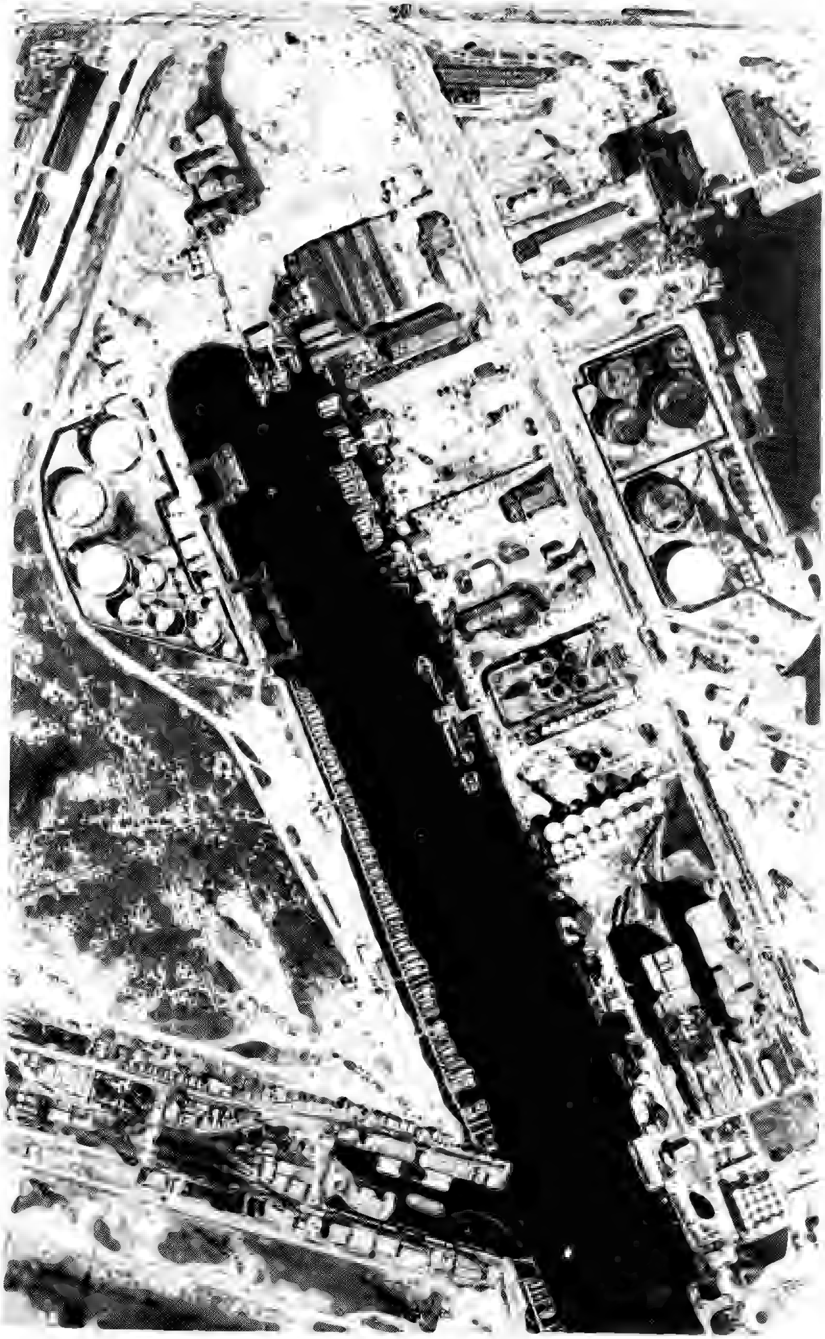


Fig. 7. Vertical view of harbor area— RF. 1″=500′

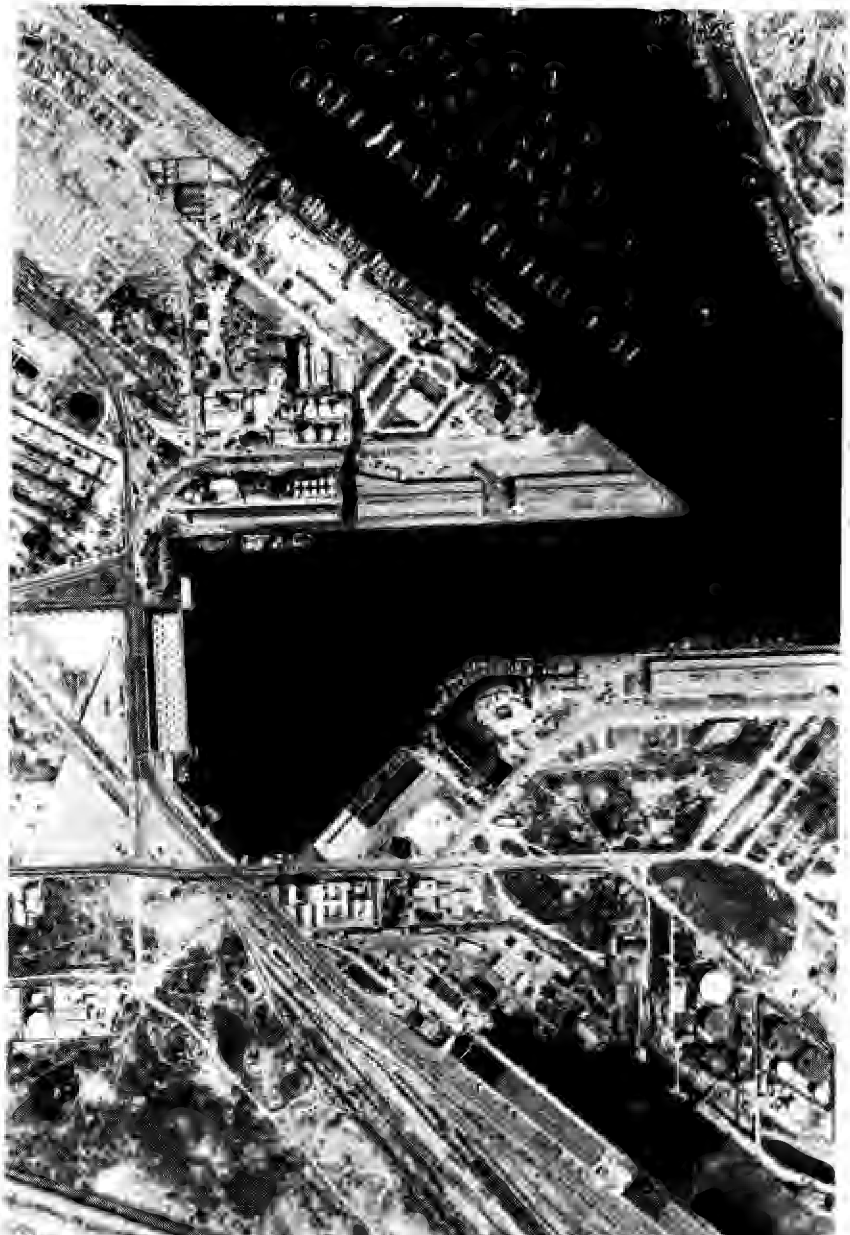


Fig. 8. Vertical view of harbor area—RF. 1″=500′

built around them. Therefore, without information to the contrary, it may be presumed that they do not contain an inflammable liquid. On the other hand, to their left will be found two large natural gas holders, which represents a very important target, as has been discussed elsewhere in this manual.

17. Further down the dock is a lone tank, obviously filled with inflammable liquids, as even in its confined space a full tank capacity concrete dike has been constructed around it.

18. Other than obviously handling petroleum products, the exact nature of the large factory, of which the above units are a part, is unidentified. In this event, as in the case of all other unidentified industries, the principal factory target becomes the powerhouse, identified by (T-4).

19. In Fig. 8 is shown a harbor area, illustrating a number of large warehouse buildings, rather extensive dock facilities, railroad yards and switches. It is recommended that those interested in the destruction of areas of this nature, study the figure carefully in order to identify the targets in order of their relative importance, as has been discussed in this chapter.

20. Wherever possible, both in the case of surface or aerial attack, ships and barges located alongside docks or in narrow harbor entrances, should be scuttled or otherwise sunk. As has been pointed out elsewhere herein, floating cranes and barges should particularly be scuttled, sunk or burned in order to handicap or prevent the repair work in the harbor area.

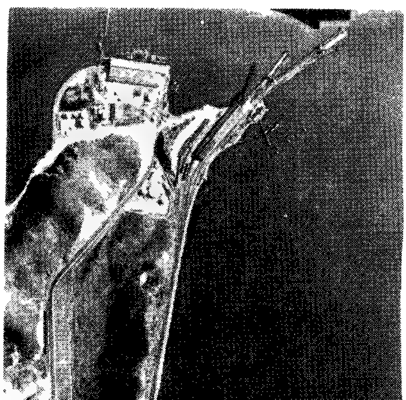


Fig. 9. Railroad ferry slip

21. Many seacoast towns rely to a great extent upon ferry service, both for the purpose of transporting passengers to and from industrial areas and, particularly, for the transportation of freight across bodies of water. Fig. 9 shows a typical ferry slip designed for the use of railroads only, and located on tidewater. The point of destruction for both surface and air attack is at the apex of the ferry slip, as here will be found a movable platform, adjustable for variations in tide levels to permit car loading.

22. Fig. 10 shows a very important ferry dock, which is obviously a part of a major railroad transportation system. Here, as in Fig. 9, the point of

attack should be at the point of the V. A hit here would either destroy or damage the movable platform, or the machinery for the control thereof. In the two ferry slips at the left in Fig. 10, the houses in which the controls are located are plainly visible at the point of the V. Damage to this power or platform unit would prevent the movement of cars to or from the ferries until repaired, which might require a month or more.

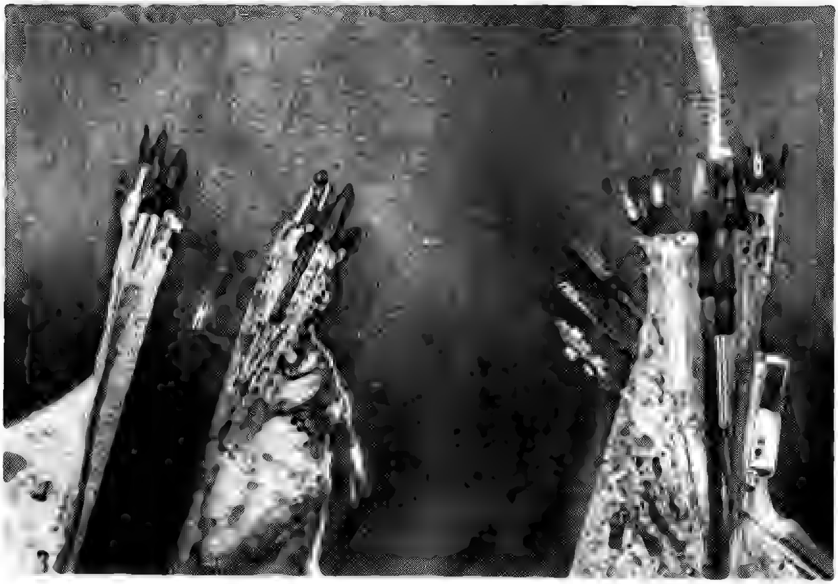


Fig. 10. Railroad and passenger ferry slips

OIL INDUSTRY—WELLS

1. The oil industry is probably second only to electrical power in the relative order of importance to the effort of any nation engaged in war. In some areas it even takes precedence over power because it becomes one of the principal sources of fuel for steam-electrical generation. Many machines of modern war function principally upon the energy of fuel oil, or one of its many refined products. Most industries on the home front depend upon it in some form to a very great extent in the production of the implements of war; and in the actual theater of operations, gasoline is essential in the use of air and surface engines.

Fig. 1. Field of pumping wells

2. Due to its extreme importance in the furtherance of war, it becomes essential that a thorough and complete study of the methods of its destruction be undertaken.

3. Oil originates from wells in certain well-known and defined areas, and these wells consist of two types, the pumping and flowing. The first are the better known, usually possessing the familiar derrick such as is shown in Fig. 1, and the flowing type (Fig. 2) is easily recognized by the "Christmas tree" piping arrangement at the top of the well. Usually a field will consist of one of the two above mentioned types. Where high pressure areas exist under the oil field surface areas the flowing type will be found throughout the entire area. However, throughout the world, the pumping or derrick type, is the most common.

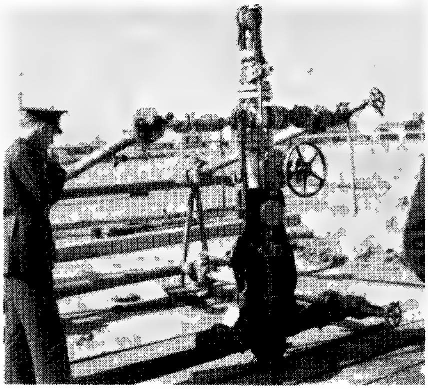


Fig. 2. Flowing well showing piping arrangement

4. Oil wells are comparatively easily destroyed, but due to the extremely large number ordinarily located within a given oil zone, a tremendously large quantity of explosives and man-hours would be required, to substantially reduce the oil production in that area.

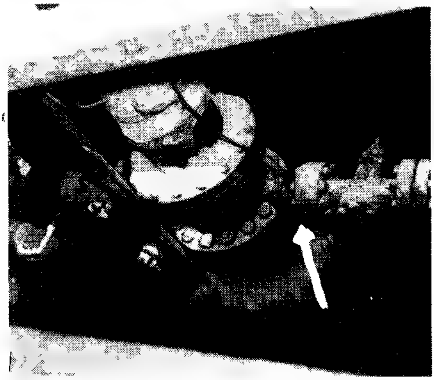


Fig. 3. Casing head

Fig. 4.
Sandbagged flowing well, showing gas trap

5. A flowing well, or field, is much more easily demolished than the pumping type, as a simple charge of explosive or thermite at the head of the well will destroy the piping arrangement, and permit the oil issuing from the casing head to be ignited, and allowed to spread over a wide area. To destroy this type of well, the explosive charge should be placed actually on the casing

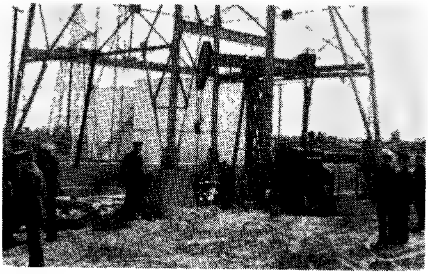


Fig. 5. Pumping well using geared gas engine

head, which is shown in Fig. 3, and is usually beneath the normal floor covering existing around the well area, and slightly below the level of the ground surface. The arrow in Fig. 3 indicates the point of joining between the casing head and the control piping, and it is at this point where the destructive force should be applied.

6. If a number of wells are to be destroyed in this manner, in a given area, some form of ignition should be contemplated at the same time the explosive force is applied. If thermite alone is used, two pounds properly placed on the casing head would normally burn through the metal cover, releasing the oil under pressure inside, and at the same time providing ignition thereto.

7. If explosives are used a thermite charge should be ignited in the area with the same electrical current that detonates the explosive, in order that a flame of sufficient heat would be burning at the same time the oil is released. Care must be taken not to place the thermite bomb or charge too close to the well-head, as the force of the explosion might otherwise scatter the thermite before ignition; and yet it must be sufficiently close to gain actual contact with the flowing oil before the thermite is burned out.

8. In oil fields where both flowing and pumping types of wells are present, and time is limited, the flowing wells only should be attacked as the resulting fire will normally spread to the surrounding pumping type wells.

9. Fig. 4 illustrates the only superstructure normally visible at a flowing type well, and in this particular well the importance of shielding from explosion is evidenced by the sandbag protection around it.

10. Near by each flowing type well will be found a unit, indicated by the arrow in Fig. 4, known as a gas trap. This unit extracts the natural gas from the oil which usually exists in a flowing well. It has some importance in the production of natural gas but is not sufficiently so to justify any appreciable amount of time in the destruction thereof.

11. In the case of pumping wells, the pump itself is the most vulnerable to destruction, but unless some action is taken toward the demolition of the

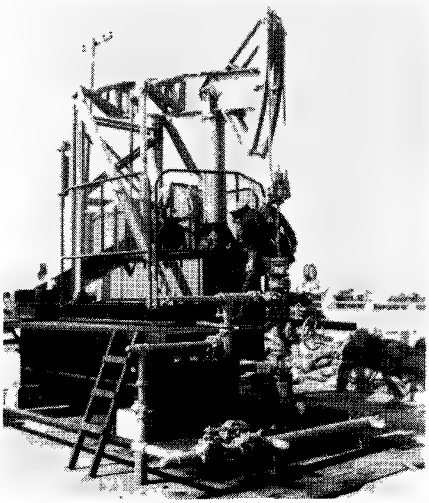


Fig. 5a
Pumping well without derrick

casing head, a new pump can usually be installed rather quickly. These pumps usually operate through gears and may be very quickly wrecked by throwing steel bars or other material into the gear box. Fig. 5 shows a typical pumping well with its pump and walking-beam arrangement.

12. After destroying the pump itself, the head of the casing column should be blown off at the ground level, and if time permits, a small charge of TNT lowered or dropped into the casing itself and exploded. If a one-half pound block of TNT is set with a one-minute fuse and dropped, it will reach the point, at the time of exploding, where the greatest amount of damage would be done. In preparing a charge of this sort, care must be exercised in taping the fuse and cap assembly firmly to the block in order that it will not be knocked out while dropping down the casing.

13. The destruction of the derrick itself is only worthwhile if sufficient time and explosives are available. The only function of the derrick is to pull the pump rod or the casing for repairs, and in an emergency some kind of a jury crane can usually be quickly installed for this purpose.

14. Usually each oil field, or each separate company within an oil field, maintains a large mobile derrick illustrated in Fig. 6. This piece of equipment should always be destroyed before leaving a field, as it is an extremely versatile machine that would be needed badly in the reconstruction of wells or other damaged oil field equipment. Before destruction the crane should be employed for tearing up pipe lines and pulling over derricks, or other steps in destruction for which

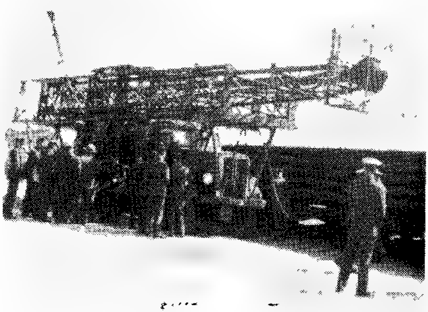


Fig. 6. Mobile oil field derrick

its power would be useful. Before departure its winches should be smashed and the engine rendered useless. To assure complete destruction, the unit could be put in motion and directed into fires which have already been started.

Fig. 7. Destruction caused by butane tank explosion

15. One of the most successful methods of destroying an oil field is to detonate the Butane or Protane tanks which will usually be found therein. Fig. 7 gives an example of the amount of destruction caused through the explosion of one Butane tank in the center of a large oil field. Almost complete destruction was accomplished over an area of 200 yards square. In some countries these liquid gas tanks are required to be constructed somewhat apart from the refining or pumping areas, due to the extreme hazard occasioned by their close proximity. The construction and appearance of these tanks, showing their recognizable features, is covered elsewhere in this manual.

OIL INDUSTRY—WELLS—AVIATION

16. As a target for aerial bombing an oil field offers tremendous possibilities, because in congested areas important hits are almost certain to be scored with each bomb. It is pointed out, however, that due to the low inflammability of crude oil, that each bombing should be immediately followed by the dropping of incendiaries, in order to ignite the exposed flowing oil.

17. A reference to Fig. 1 will indicate the extreme vulnerability to aerial bombing of a typical congested district. The majority of the derricks illustrated therein are wooden, and therefore would easily be destroyed by fire of any consequence in their immediate vicinity. This is a field composed of small independent producer wells, in which the storage of the pumped oil, and in some cases, the first refining processes, are accomplished in the well area. In most modern oil fields the storage and refining process will not be in the vicinity of the well itself. Some storage tanks will usually be in the vicinity of the wells, and the oil may then be pumped through pipes and a succession of pumping stations to a refinery, in many cases on tidewater hundreds of miles away. If the oil field shown in Fig. 1 was the target of a bombing mission, the center of the target area would obviously be storage tanks, shown by the arrow, in the upper right portion of the picture. With demolition and incendiary bombs the tanks and dikes would be breached and the burning oil would through gravity flow downward into the other areas at the base of the hill.

18. As will be pointed out elsewhere in this chapter, it is almost as necessary to breach the dike usually surrounding each tank, as it is to breach the tank itself. Each dike area is designed to hold all the oil contents of its tank at normal temperature, and each tank is normally sufficiently far from the nearest other tank to permit the one to burn without igniting the other. Therefore, it is very important to breach the surrounding dikes that the oil may flow out and toward the other critical areas. Burning oil expands eight to ten times normal volume, but it is only the heated top few inches that expand, and this is hardly sufficient to carry a large volume of burning oil over an unbroken dike and into other critical areas.

19. Fig. 8 shows a typical small refining operation, with the large storage tanks in the foreground, the run tanks in the center, and the retorts, stills

and fractionating tower in the middle distance. While target areas within a refinery itself will be covered elsewhere herein, it is desired to point out here, where a dike should be breached in order to do the greatest damage. Point (T-1) on Fig. 8 should be the target in order to breach two dikes between each tank, and on the refinery side of the "tank farm." Burning oil pouring through this opening, from breached and ignited tanks, would reach

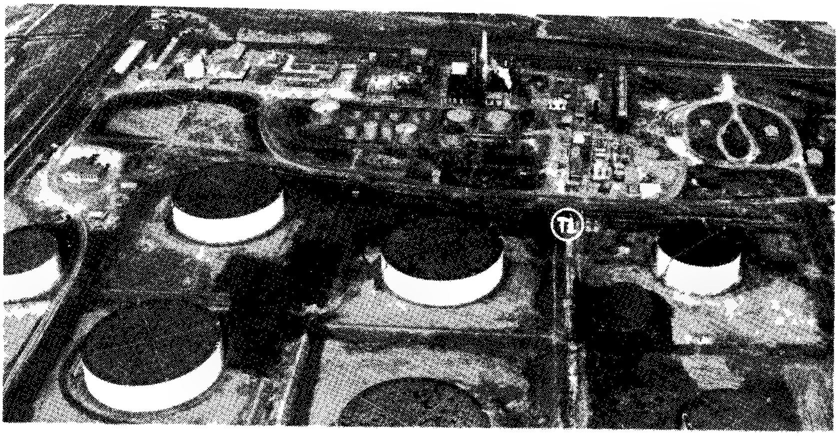


Fig. 8. Small refinery showing storage and run tanks

the gasoline and vapor recovery units in the right center and ignite them, and from there to the retorts. If this outside dike were not breached the entire tank farm could be destroyed by fire without necessarily damaging the refinery itself, which is the most important item.

20. Within the target area indicated above will be seen two longitudinal tanks, which obviously contain a highly inflammable gas due to their isolation, and the catwalk and valve assembly on top of each. These should be breached by a surface detail simultaneous with the dike and tank breaching, and they would naturally explode from pressure and rupture by a near miss from an aerial bomb.

21. The sphere in the right foreground contains natural gas under pressure, and extracted from the crude during distillation. Its contents are only explosive and combustible when mixed with the correct proportion of air, and therefore should be strafed or subjected to small arms fire for effective destruction. The metal is light, as it secures its strength from design, and is easily penetrated with small calibre ammunition. Ignition of the escaping gas cannot be well accomplished near the ground as the gas rises quickly and reaches a combustible mixture as it rises. Therefore after rupture it should be subjected to tracer fire at various altitudes above the tank until ignition is obtained.

OIL INDUSTRY—REFINERIES

22. Probably the most accessible and vulnerable installation of an oil refinery are the storage tanks shown in Fig. 9. As indicated in the preceding paragraphs of this manual, these storage tanks are usually located in close proximity to the refinery, with smaller run tanks located immediately adjacent to the retorts and stills, which handle run or daily refining requirements.

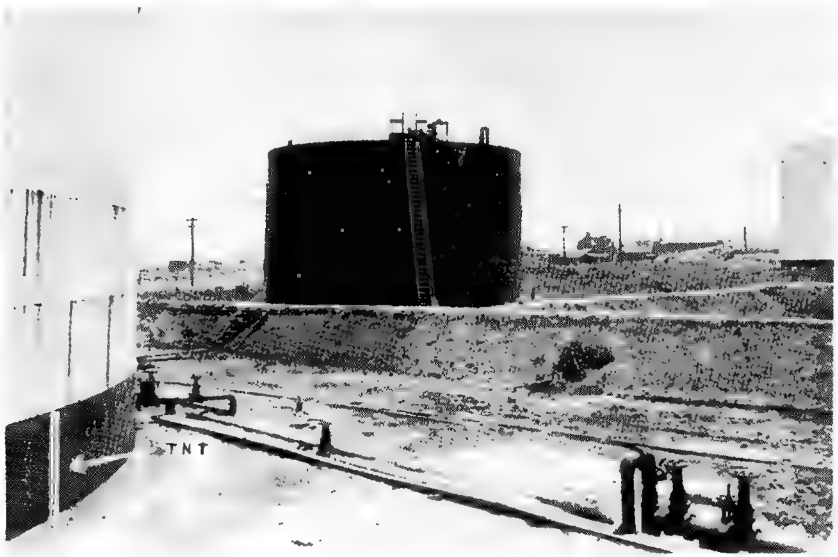


Fig. 9. Oil storage tanks and dikes

23. Fig. 9 also shows a closeup of the tank dike area and indicates the necessity for the breaching of these dikes to permit the oil to flow out. The tanks are made of comparatively thin sheet metal, in riveted sections with lapped and butted joints, and are comparatively easily breached. A sufficient charge of explosives should be placed at a joint at the bottom of the tank, preferably digging away a portion of the ground in order to back the force of the explosive against the tank itself. Blocks of TNT should be placed end on end along the length of one of the end seams of a plate, as shown in the figure, in order to insure a sufficient opening to feed a large fire.

24. It is particularly important to breach the tanks at the bottom, as in many cases the tank may be comparatively empty and no value would be gained in opening at a higher point. Also, before the charge is placed the tank should be "sounded" to determine whether or not it is empty. This can be done by hitting the lower sections with some metallic object.

25. Little value will be obtained by puncturing crude or fuel oil tanks with small arms fire, as the openings are not sufficiently large enough to do any appreciable damage, and could be quickly repaired.

Fig. 10. Oil storage tanks burning

26. Fig. 10 shows a number of oil tanks in the process of burning. The one on the left shows how the receptacle itself has been melted down to the dike top level, and the process of burning is continuing. The tank on the right is burning at the top and unless the flame is extinguished by foamite, or other chemical smothering type extinguisher, it will probably be consumed to the ground.

27. In Fig. 10 streams of water are being played on the tank fires but it is pointed out that this can have but little value in the extinguishing of same, except to subdue or control fires of other materials burning nearby. Water has little or no value in the extinguishing of any type of petroleum fire, and only the chemical smothering type is effective in such instances.

Fig. 11. Gasoline storage tanks

28. In most refinery areas will be found gasoline storage tanks similar to those shown in Fig. 11. Gasoline is usually stored in cylindrical, horizontal tanks, and these, of course, are extremely vulnerable to destruction. These tanks contain safety valves, which permit the exhaust of expanded gasses from temperature variation, but these valves have small capacity and will not permit the escape of quickly developed pressures through the appli-

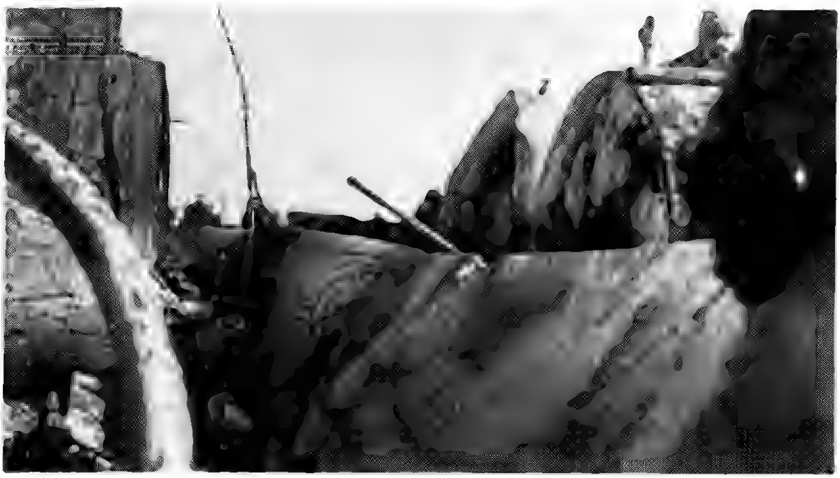


Fig. 12. Gasoline and oil storage tanks after fire

cation of heat around the outside of the tank. Therefore, if a fire of any consequence from fuel oil tanks can be directed into the vicinity of gasoline storage tanks, these will burst from the increased pressures, and will explode when the heated gases come in contact with the flame.

29. Fig. 12 shows the effect of burning gasoline and fuel oil in a concrete diked area. The tanks on the left contained fuel oil, and those on the right, gasoline. They, were not only completely demolished as a result of this fire but also the area for several hundred yards around. It is practically impossible to control a fire of this nature after it spreads over a considerable area and has sufficient fuel upon which to feed.

Fig. 13. Fractionating towers, gas tanks and well derricks

30. Thermite bombs are especially efficient in the breaching of gasoline storage tanks, as they will burn a sufficiently large opening through the tank to permit the outward flow of a large quantity of gasoline, igniting the same upon contact. In this connection the thermite should be placed at the bottom of the tank in order to permit the liquid gasoline to escape under pressure, and flow over a wide area while gasifying. A charge on top of the tank would be very effective on a partially filled tank, as the gas in the upper portion of the tank would probably explode and burst the tank when the thermite burned through. It is advisable to place two thermite charges on this type of operation, the first as a breach charge against the tank itself, and the second eight or ten feet away to insure ignition of the escaping gasoline.

Fig. 14. Stacks, fractionating towers and gas holder

31. Thermite is excellent for breaching and igniting tanks of distillate, kerosene, solvents, etc. On the other hand, it is not considered adequate for the breaching of an oil storage tank, as it will not cause a sufficiently large opening in the tank before being carried away by the rush of escaping oil.

32. Fractionating towers, Figs. 13, 15 and 15a, are among the most important units of an oil refinery, particularly a refinery engaged in the manufacture of high-test or aviation gasoline. These towers are ordinarily the tallest in a refinery area and are easily distinguished.

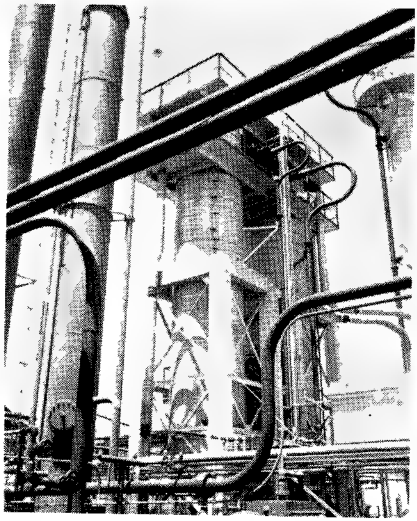


Fig. 15. Fractionating towers

Fig 15a. Fractionating towers

Fig. 14 shows several fractionating units of various types, although the towers should not be confused with the stacks from retorts, of which there are three visible in Fig. 14.

33. A natural gas holder of the guide frame type is also visible on the right of Fig. 14 in its half-filled position. As is pointed out elsewhere in this manual, this type gas tank, or cylindrical or spherical high pressure gas tanks, may sometimes be located in a refinery or well area, but usually so only when those areas are close to a metropolitan center.

34. Due to the size and rugged construction of a fractionating tower, the most practical method of destruction would be to knock out two or more of the supporting columns on the same side at the base with explosive charges. Severance or bending of these columns, shown in Fig. 16, would probably cause the tower to topple in that direction, not only tearing apart all of its own piping but smashing all other equipment in its path. The tower contains a hot and highly inflammable liquid undergoing a distillation

of several grouped gauges and dials. These controls indicate the temperature and pressure of the liquids under distillation, are specially built and very important to the operation of the tower. If this board were demolished and no other damage done, the tower would probably be out of operation for a period of thirty days.

process, and is subject to ignition by admission of the slightest spark.

35. If explosives are not available to destroy or topple the tower, the pipes leading to and from the tower should be breached and the flowing contents ignited. In all probability the resulting fire would be sufficient to destroy the entire unit, and probably the other critical elements of the refinery, unless it were immediately brought under control.

36. The control board for all fractionating towers is located close to the base of the tower, and it is easily recognized as it is composed

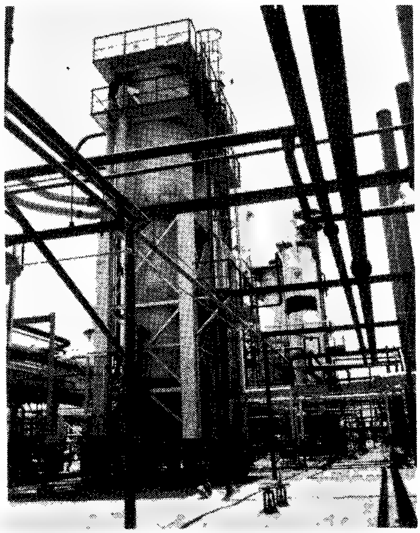


Fig. 16. Fractionating towers

37. The several fractionating towers of a large refinery will normally be grouped in one small area where the cracking process takes place, and usually the control boards and instruments for all towers are located at one point close by. If only a few of the demolition detail reach the refinery, and if time and explosives are limited, this should be the first object to destroy; and it could be easily done with a sledge hammer or other heavy object in two or three minutes. The board is made up of simple electrical equipment actuated by low voltages that are perfectly safe to handle.

38. The retort, shown in Fig. 17, of a refinery is very important and comparatively easy to demolish if some explosives are available. The walls are of fire-brick and steel sheathing which can be easily breached with small charges. These retorts contain a large amount of hot oil under pressure, and once the oil is released it becomes highly volatile and combustible. Some flame may have to be introduced in order to start combustion, and a thermite bomb or some other open flame should be burning in the vicinity at the time the breach charge is detonated. All members of the detail engaged in this work are cautioned to be well away from the area at the time of detonation, because the hot burning oil will be thrown over a very wide area. These retorts are normally located quite close together. if

Fig. (a) Fractionating towers are highly vulnerable and should be destroyed

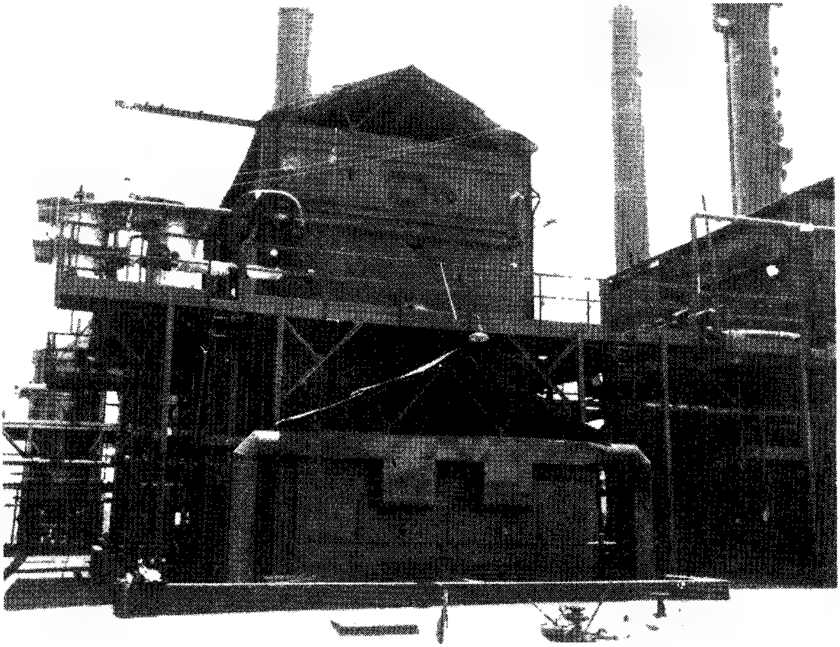


Fig. 17. Retort

there should be more than one, and it is advisable to prepare for a simultaneous explosion against all retorts for the most effective destruction.

39. The stack of the retort is important to its operation, and if time permits should be destroyed. However, improvised smaller stacks with blowers can be quickly provided, and therefore, unless complete destruction is desired these may be left alone. Fig. 18 illustrates a stack, and also its close proximity to the retort. It becomes evident that if the retort is breached and the hot oil fired that the heat would be sufficient to probably destroy the stack or render it useless.

40. At the base of the stack will be seen a wheeled vehicle, which is a chemical fire extinguisher, of which many will be found around or near the critical elements in a refinery.

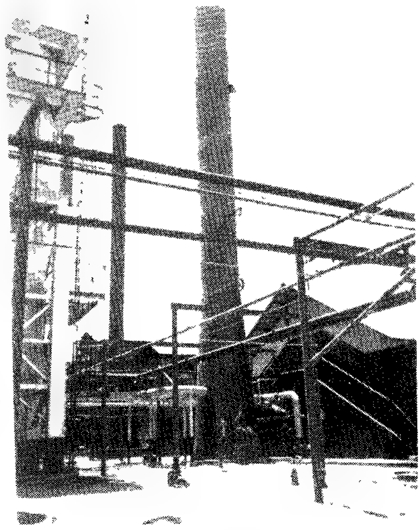


Fig. 18. Stack base showing mobile chemical fire extinguisher

When the detail first approaches the plant, one or more men should be assigned the duty of rounding up and destroying, or otherwise rendering immobile, these units.

41. A highly volatile liquid sometimes known as Butane, Protane, Propane or some other similar trade name, is produced by most oil refineries. This is a liquid gas stored under rather high pressure, in tanks which are usually cylindrical, with hemispherical ends, supported horizontally and easily recognized by their strong construction. As a rule these Butane tanks are usually located some distance away from the refinery, although very often they will be found within the refinery area itself.

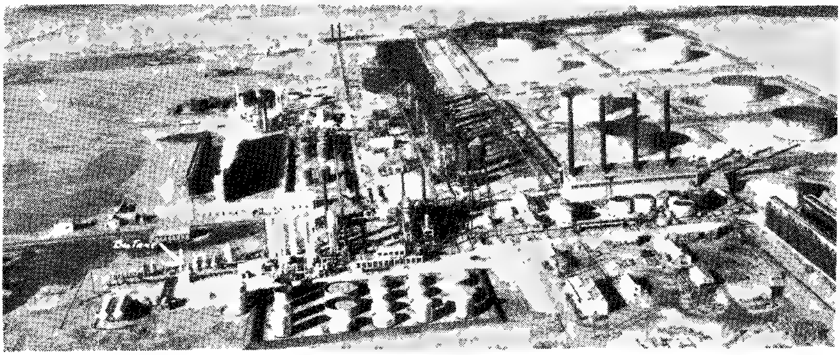


Fig. 19. Oil refinery

42. In the lower left hand corner of Fig. 19, indicated by an arrow, will be found two of these tanks, and recognized from the normal cylindrical type tank by the hemispherical ends, which are necessary to retain the pressure of the tank. Breaching one of these tanks releases the pressure and the liquid, which immediately reverts to its gaseous state. It has extreme buoyancy in its gaseous form and rises quickly, becoming highly explosive when mixed with the correct proportion of air.

43. Any demolition effort against these tanks should be done at a safe distance, and after rupture, tracer bullets should be fired above the tank in order to insure ignition of the escaping gas, as normally nothing more than a spark is required in the combustible zone.

44. Figs. 20, 21, and 22 show the effect, both while burning and afterwards, of the explosion of one medium-sized Butane tank. This particular tank became heated from the sun and the relief valve failed to function in releasing the increased pressure. Expanding gasses burst the tank and exploded with such force as to demolish practically everything within the vicinity. Some appreciation of the value of this gas to the demolition effort, can be gained by an examination of these photographs.

Fig. 20. Fire caused by explosion of butane tank from sun

45. Pipe lines will be found throughout the entire refinery area and these carry a large assortment of liquids and some gasses. These are principally crude oil, gasoline, natural gas, steam, water, and foamite chemicals and various other refinery products, mostly combustible. If the pipes are

Fig. 21. After butane tank explosion

Fig. 22. Butane wreckage

breached at any point, and the inflammable liquid issuing therefrom set afire, the damage could be quite extensive. It is not considered that this phase of destruction is important, however, unless sufficient time permits, and the other more important phases of destruction discussed herein have been completed. Fig. 23 shows a typical piping section in the run tank yard of a refinery and illustrates the large amount of demolition work required if these were to be destroyed.

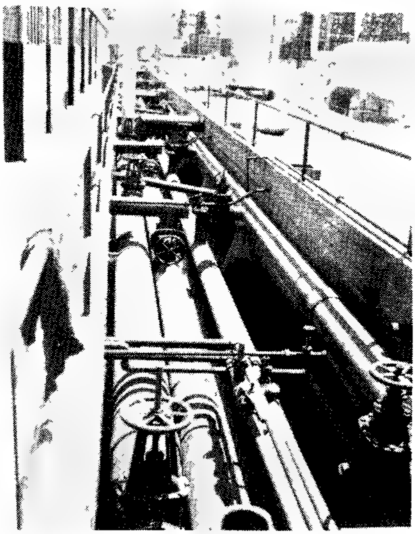


Fig. 23.
Some refinery piping

46. If time and explosives permit, and it is considered advisable to destroy certain pipe installations, care should be exercised to destroy those sections where valves, pumps and other special mechanical devices exist. Fig. 24 illustrates the pumping arrangement in an oil pump house showing two centrifugal pumps as normally installed and it is here where important damage to piping and pumping facilities would be accomplished. The same is true in the piping

Fig. 23a. Detail of gas traps

arrangement of the gas collector illustrated in Fig. 26, as here the destruction of any portion of the valve assemblies would be much more difficult to replace than a mere section of pipe.

Fig. 24. Oil pumps

47. One of the very important units at a refinery making high-test, or aviation gasoline, is the absorption plant. This plant is small in size and operates normally through two pieces of equipment; the first, Fig. 25, is known as the casing head gas collector, which separates the gas from the oil as it flows from the well. The vapor recovery unit, illustrated in Fig. 26, then compresses the gas in the second step, forming a highly volatile liquid from which the gasoline is extracted. The important features of the recovery unit are the two horizontal tanks, as shown in the center of Fig. 26, and these become the object of any destructive effort

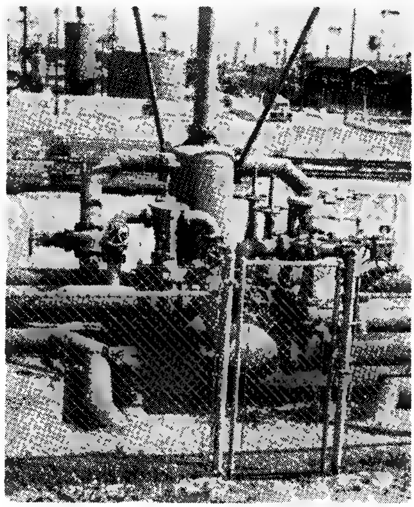


Fig. 25. Gas collector

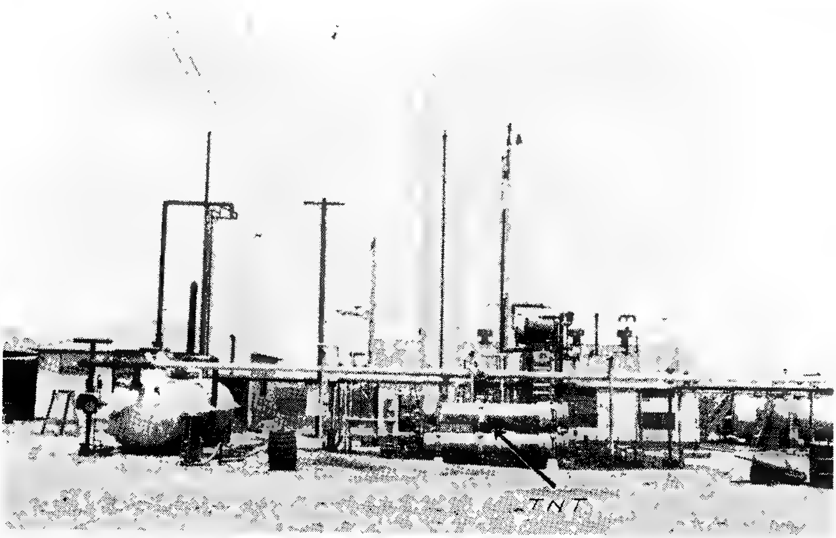


Fig. 26. Absorption plant

against high-test gasoline production. These tanks are usually constructed of a very heavy steel as they contain unusually high pressures. A normal charge of thermite is hardly sufficient to burn through and therefore a packed charge of TNT should be employed. The tanks are usually super-

imposed one over the other, and the most effective method of destruction would be to stack one-half pound blocks of TNT firmly between successive units, at the point indicated in Fig. 26.

Fig. 27. Water cooling towers

48. Water is important to a refinery principally through its use in condensers and cooling towers, illustrated in Fig. 27. However, unless the outside and internal well supply of water is destroyed, jury water arrangements can usually be quickly arranged. Most refineries have two sources of water, one being the community or public system, and the other a series of wells and pumps within the refinery area. While water is of no value in fighting petroleum fires, it is important to the operation of a refinery and, therefore, if time permits, some effort should be made to destroy the well pumps, and the valve arrangement to the public supply, if possible.

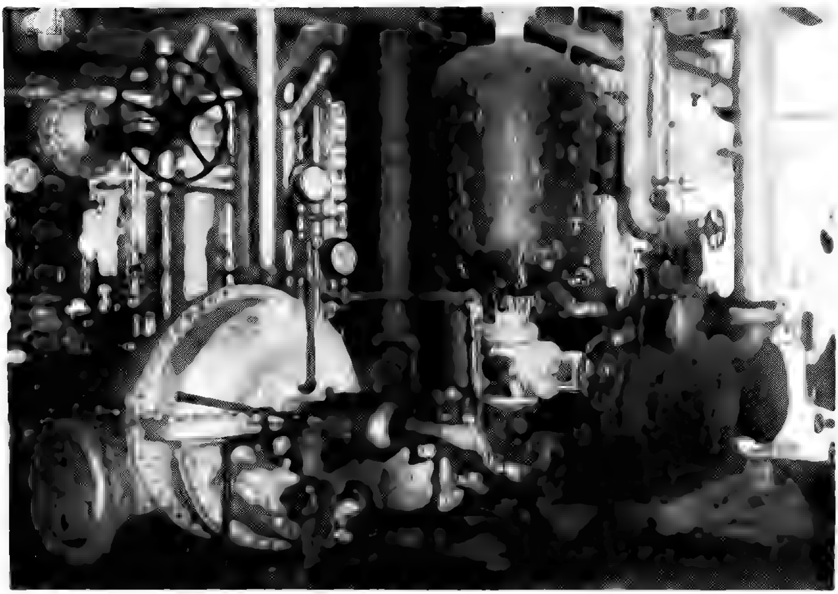


Fig. 27a. Turbine turning oil pump

Fig. 27b. Steam turbo-generator in refinery powerhouse

49. The power unit, which is usually a conventional type steam or Diesel electric turbine, should be destroyed after the power requirements of the destructive mission have been exhausted. Probably the most effective and quickest method by which this could be done, would be by employing the method described in the power chapter of this manual, on self-energized destruction of the turbine itself. This, however, is possible only in a steam or hydro installation as it is impossible to turn an internal combustion engine at sufficient RPM's to destroy the generator unit. On a Diesel installation it would be necessary to resort to explosive or incendiaries. It is considered that the power unit of a refinery is probably the least important installation to destroy, mainly because of the fact, that a well organized and well executed sabotage mission in a refinery, will release sufficient combustible liquids, which, when ignited, will overrun and destroy the power plant very effectively.

Fig. 28. Foamite storage tanks

50. The principal fire prevention feature of an oil refinery is an extinguishing agent known as foamite. Foamite is the product of the mixture of two chemicals, which expand approximately fourteen times upon mixture, and form a foam sufficiently heavy to smother most small oil fires. The chemicals are usually stored in two tanks, similar to those illustrated in Fig. 28, and are piped through the entire area by two pipes, each of which carries one of the chemicals. Unless they possess some other distinguishing

mark or feature, they can usually be recognized as two of the smallest pipes in a refinery, and are always parallel. One of the first movements of the demolition detail should be to breach one of the tanks, or otherwise disrupt one pipe system at the supply tank source. This will render the principal fire extinguishing agent useless through the entire plant, and make certain that the fires will complete the destructive mission.

Fig. (b) Oil refinery in Japan

OIL INDUSTRY—REFINERIES—AVIATION

51. In order to familiarize both air and ground personnel with the appearance of various installations within a typical refinery area, a study of Fig. 29 is suggested. This is a very modern petroleum refining plant, engaged in the manufacture of chemicals and gasses of a higher refined nature. It is distributed over a wider area than would be normally found, except in the most modern plants, but the general relationship of one unit to another can be established through study of this picture.

- (a) Storage and run tanks,
- (b) Condensing water cooling towers,
- (c) Fractionating towers,
- (d) Vapor recovery unit,
- (e) Butane tanks,
- (f) Retorts,
- (g) Stacks from powerhouse.

Other installations shown in this illustration, and not covered in this chapter on refineries, consist of several special units for the extraction of solvents and other chemicals, which are not considered essential to this work. Fig. 30 (RF 1″=1000′) shows the same plant vertically and its proximity to the principal refinery of which it is a part.

52. Fig. 31 illustrates a highly congested refinery area showing all the essential equipment and operations of a large refining unit. (a) represents a series of retorts of a type not shown elsewhere in this chapter.

53. (T-1) indicates the installation of a series of new type fractionating towers, which are reproduced in larger scale in Fig. 32. For aerial attack this would be the target of principal importance as a near-miss would more than likely breach one or more of the tanks, and release the highly volatile hot liquid to a very destructive fire.

54. The target of second importance would be along the fuel oil tanks, indicated by T-2, always attempting to breach the area of tanks and surrounding dike on the downhill and refinery side. It has been pointed out previously that the metal in these tanks is normally quite thin gauge, and will not require a direct hit, but may be breached by the force of nearby concussion, particularly, if the tank is full.

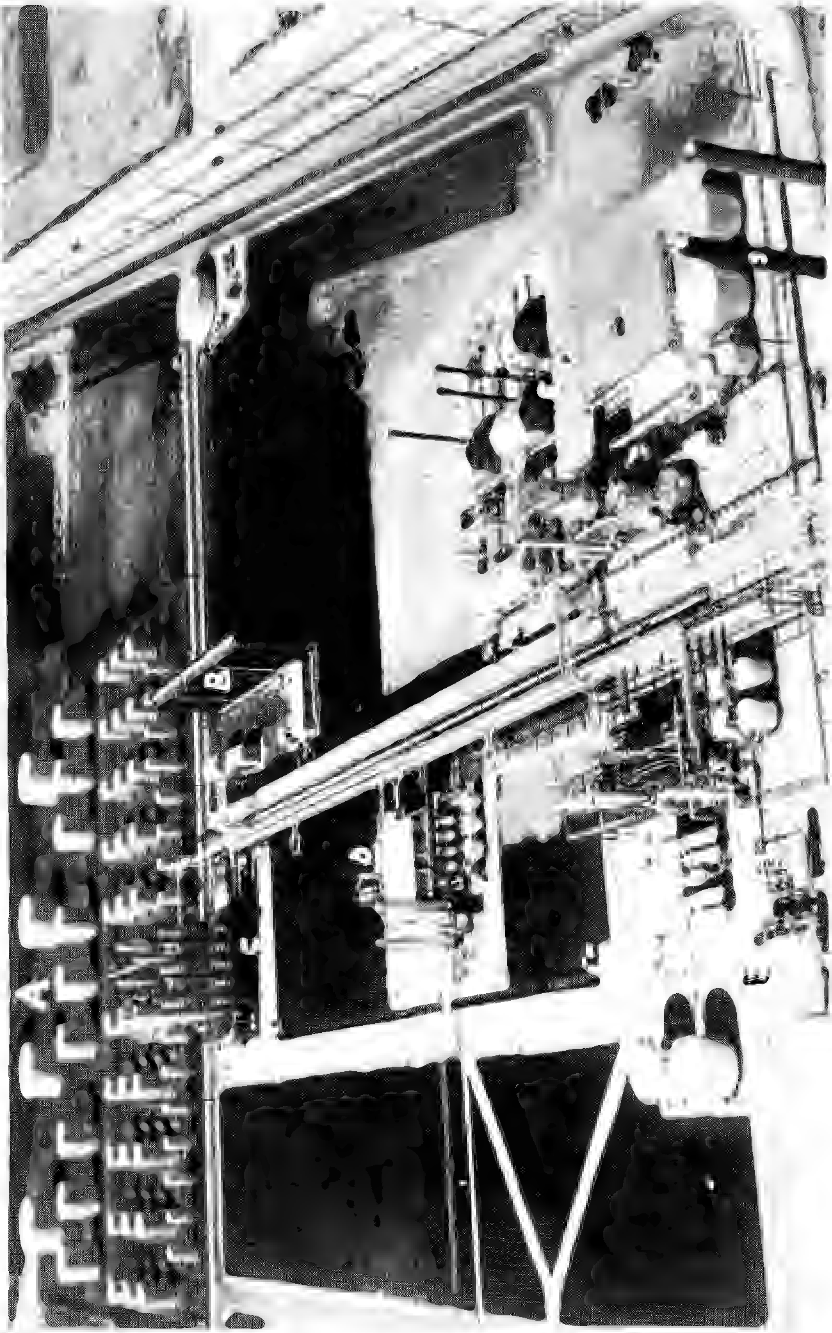


Fig. 29. Chemical plant

Fig. 30. Refinery showing chemical plant in upper right

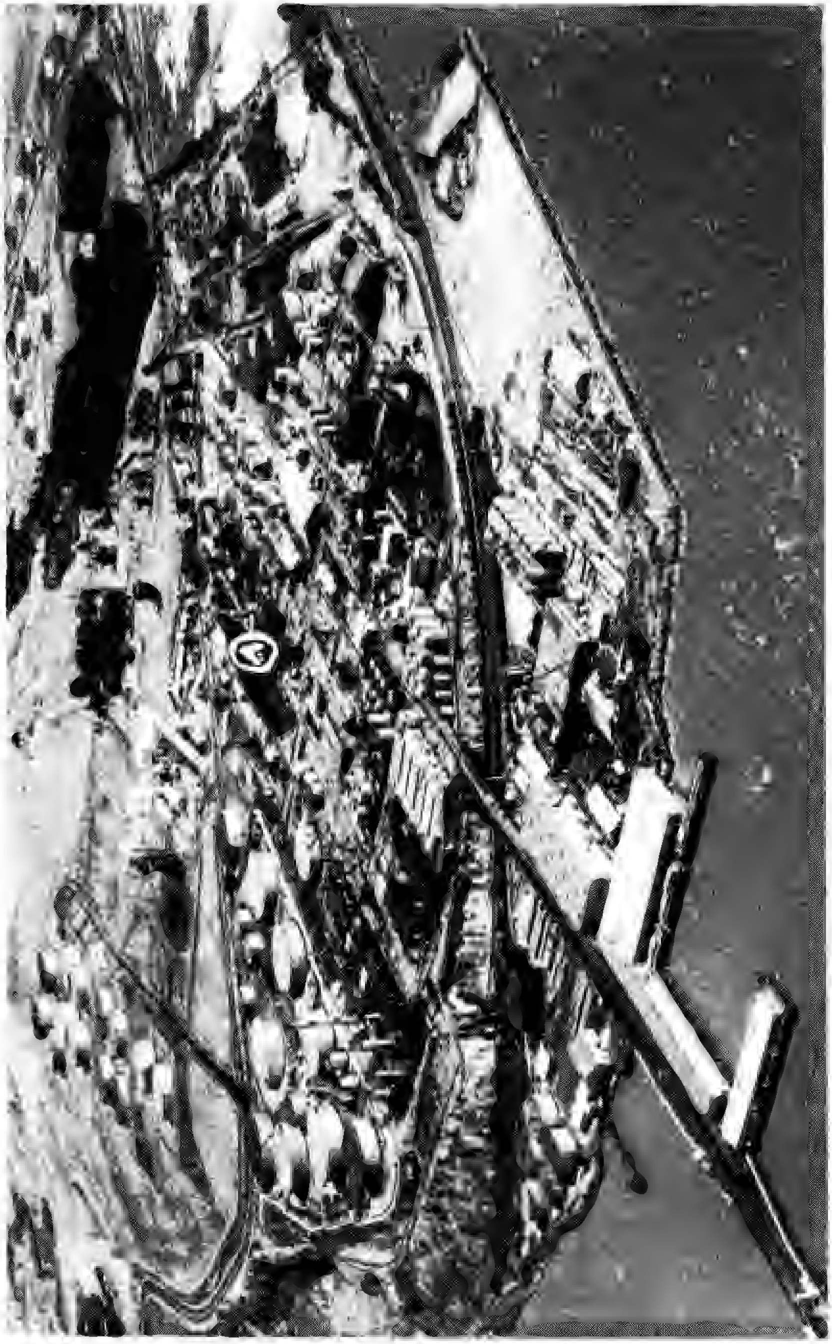


Fig. 31. Oil refinery

55. In this connection, throughout this chapter will be found reference to "storage and run tanks" and it is again pointed out that the storage tank, though normally the furtherest from the refinery area, should be the target, as these will usually be full or nearly full of crude oil, while the run tanks may be nearly empty.

56. The target of next importance would be the area of the retorts, indicated by T-3, although normally these would be destroyed if hits were obtained on or near T-1 or T-2.

57. All other areas within the refinery are of less importance than those indicated above. The immediate foreground shows the buildings and tanks where drums are filled with fuel oils, gasolines and distillate for shipment. Obviously, the vertical tanks would be the principal target here as one hit would probably cause a fire that would destroy the filling and storage buildings in the left center foreground, as well as ruin the empty tanks on the Berm.

58. Fig. 32, which is a closeup of T-1 described above, shows the intricate pipe pattern of a series of fractioning units. The arrow indicates the vapor recovery unit of this installation, composed of three superimposed vertical tanks, which with the towers, constitute the principal items for destruction within this area.

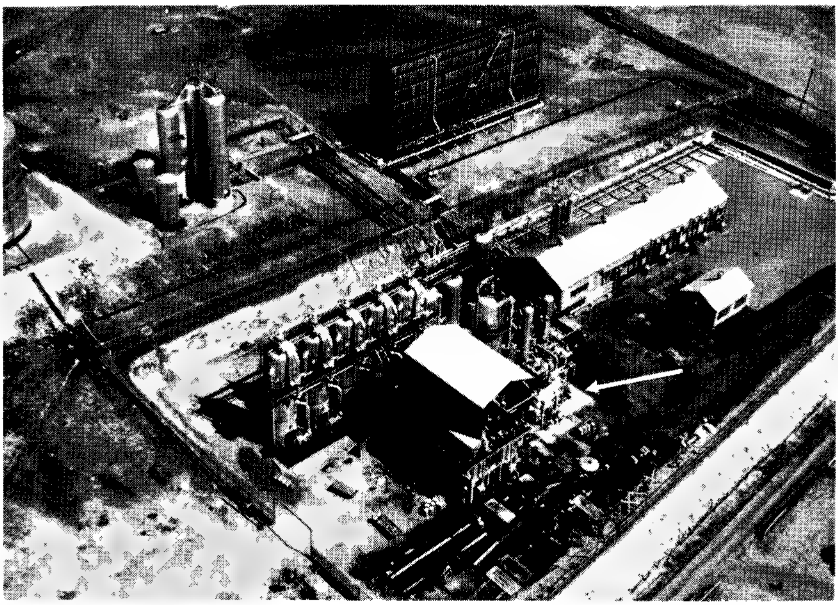


Fig. 32. Closeup of fractionating towers of Fig. 31

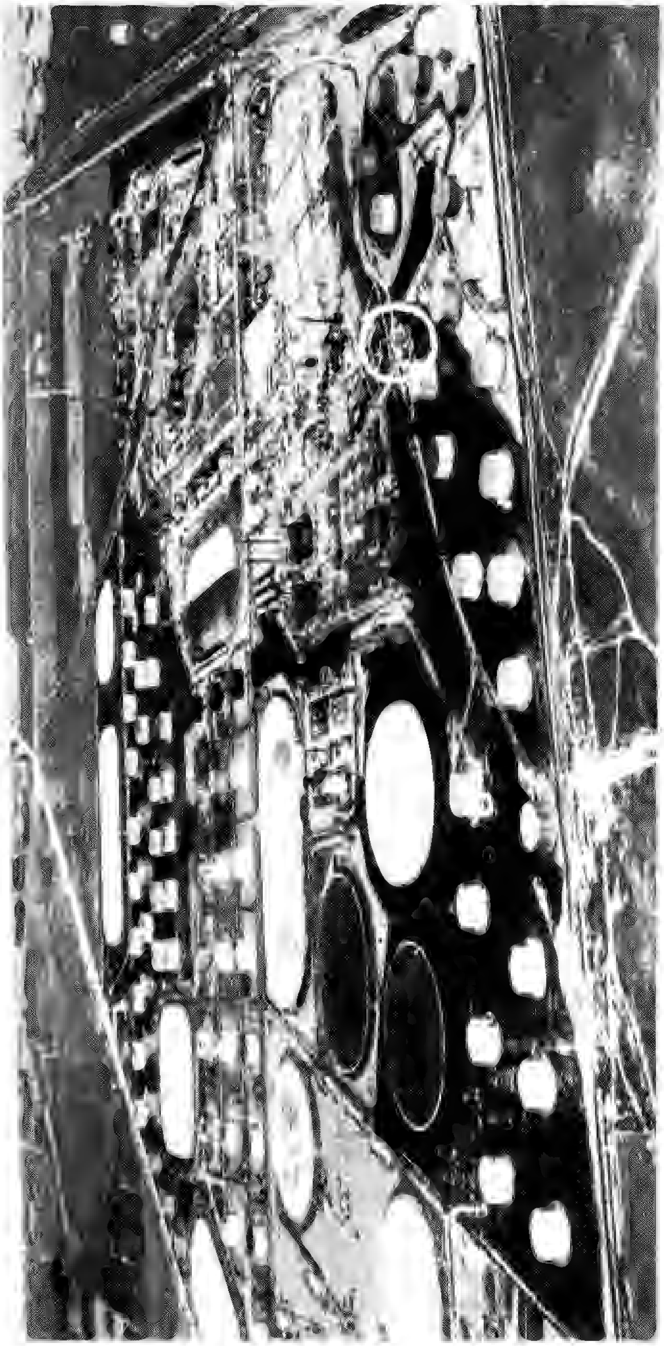


Fig. 33. Oblique of large refinery

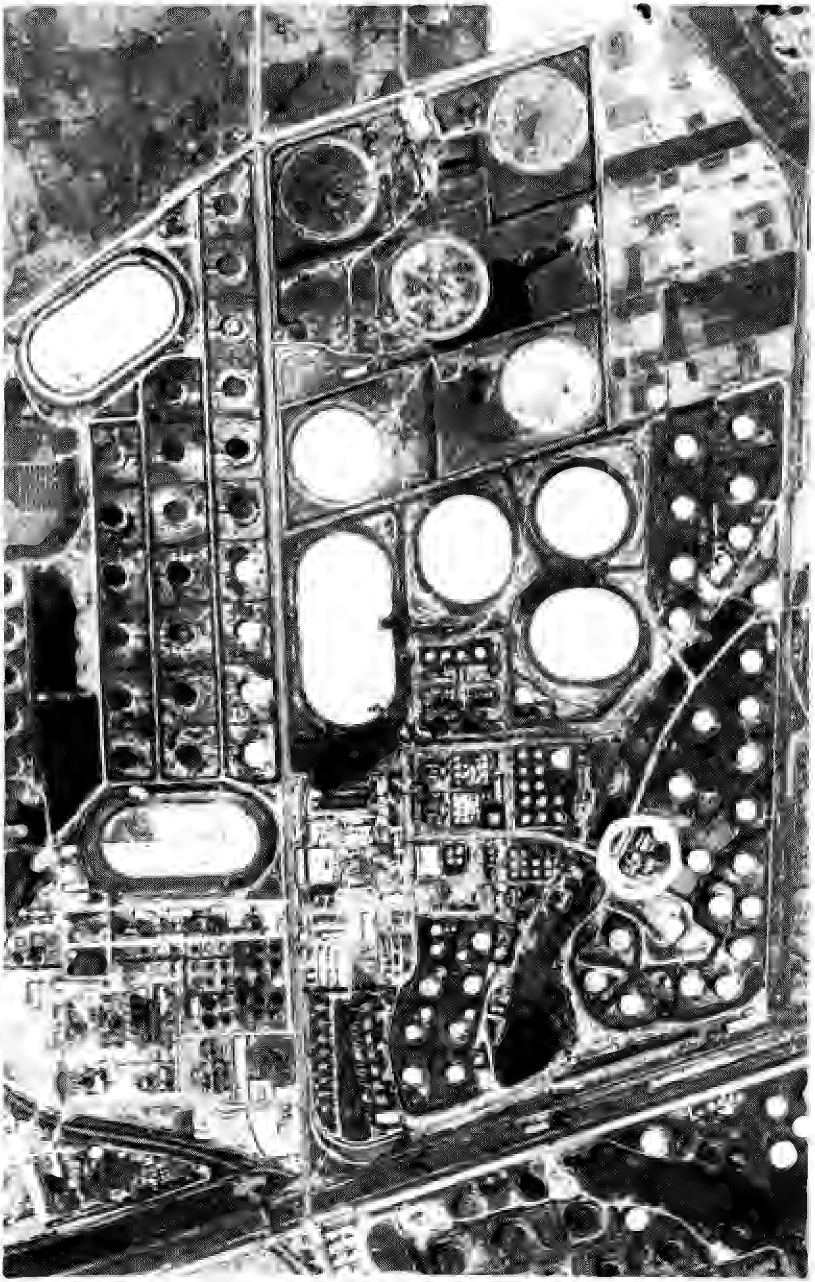


Fig. 34. Vertical view of Fig. 33

59. A very large modern refinery is illustrated in Fig. 33 and Fig. 34 shows a vertical view of the same area. The RF of the vertical is 1″ equals 1000′, and the approximate scale across the center of the oblique (Fig. 33) is 1″ equals 800′.

60. These two photographs are recommended for detailed study, and identification of all refinery objects therein, both by ground demolition, and aerial bombing, students, as here a correct vertical and oblique identification can be secured of identical important installations. The attention of the student is directed to the one spherical, the four vertical cylindrical, and the two horizontal cylindrical tanks in the circle. The sphere and the vertical tanks contain natural gas, and the two horizontal tanks with hemispherical ends contain Butane under pressure. To an aerial bombing mission these two are the target of first importance. They are equally important to a ground demolition detail, as covered elsewhere herein, but would normally be left to the end of the allotted time, providing the program called for the destruction of fractionating towers, storage and other units.

61. The aerial student is cautioned that in these photographs he is presented with an excellent opportunity to study the uncamouflaged appearance, and relative placing, of important refinery units. He must become so thoroughly familiar with their appearance in this state, that he will be able to recognize their characteristics under the typical camouflage screen, with which any vulnerable refinery area would be provided.

62. To an aerial gunner without bombs on a strafing mission, the spherical and cylindrical shaped tanks discussed above, would be his only target, because here a few well-aimed bursts of ball and tracer fire would effect destruction over a wide area. His most important target would be the horizontal Butane tanks, and with 30 calibre ammunition the fire must be directed against the ends, where the steel is only half as thick as on the sides.

STEEL INDUSTRY

1. Steel mills may be said to be one of the most important industrial activities in the production-for-war effort of any nation. Most of the machines of modern warfare get their start in the blast furnace of a steel mill, and, therefore, any disruption or curtailment of raw steel production would have a very serious effect until the output was restored. There are a number of different types of mills engaged in the production of steel, and its many component or more refined products, but all essentially operate on the same basis. Some mills produce only sheet steel, others, bars or rails, some make tubing only, and others special or unusually large castings.

Fig. 1. Steel mill furnaces

2. As stated above, basically these mills appear the same in plan and profile, as the operation usually begins at the ore bins or scrap piles, into the blast furnaces, and from there into the various other buildings in which the steel is given form. The principal difference in appearance is merely the size of the area covered, and the number of buildings therein.

3. The most essential part of any steel mill activity is located in the furnace area. In wartime most furnaces operate on a twenty-four hour continous basis, and at their full capacity, as there is very seldom a supply of steel on hand to enable the remainder of the mill to continue working if the furnaces are put out of operation for any reason.

Fig. 2. Concrete pier and furnace floor

4. These furnaces are, dependent on the capacity of the plant, very heavily built and consequently difficult to destroy. Fig. 1 shows the nature of typical furnace construction on the loading floor level. The floor of the furnace itself is normally built upon reinforced concrete piers of the general type shown in Fig. 2. This is on the ground level and underneath the furnaces shown in Fig. 1. To destroy a furnace a sufficient charge should be packed between the reinforced concrete steel beams shown in the upper portion of Fig. 2. The floor at this particular point will probably be between 20 and 30 inches in thickness but of a low tensile strength, and will normally shatter quite easily if sufficient explosives are used. The shattering of this floor would practically require the rebuilding of the entire furnace, as it is almost impossible to repair the floor without reconstructing the other portions of the furnace at the same time.

Fig. (a) Shows steel foundry in Anshan, Japan

5. Lead and tin will eat holes through the floor of a blast furnace but it would require one or two hundred pounds in each furnace to do an effective job. To rebuild a furnace damaged through an explosion or through the eating process described above, it would require anywhere from one to three months, depending upon the size thereof.

Fig. 3. Furnace charging machine

6. It should be unnecessary to warn members of the detail effecting an explosive breach of the furnace floor, in a manner described herein, to secure both adequate cover and distance at the time of explosion, to avoid the dispersion of molten metal that would be released.

7. These furnaces are charged by a unit known as the charging machine, of a type similar to that shown in Fig. 3. Here the machine is in the process of charging a furnace with material from the cars in front of the furnace doors. This charging machine is very vulnerable to attack as it can be easily destroyed, and it is unlikely that the average plant will contain more than one spare, which of course, should be destroyed also. The destructive effort should be directed toward the base, as this is usually a specially cast affair and more difficult to replace than the charging arm, or the motive power.

8. In the event of insufficient explosives to destroy the furnace floors, the efforts of the detail should be directed toward the destruction of this machine, which could be accomplished with much less explosives, or with thermite. Destruction or damage to the charging machine would require manual feeding of the furnaces, which with the average modern type of blast furnace is practically impossible.

9. In the rear of the blast furnaces will be found a huge ladle and crane, shown in Figs. 4 and 5. This ladle receives the molten metal from the furnaces and pours it into the molds, shown in the center foreground of Fig. 5.

10. This crane and ladle combination possesses tremendous power for the destruction of various equipment in the mold and furnace room. An experienced crane operator could set the ladle swinging and in this manner it could be used to crush the walls of the furnaces by swinging it against them. The crane itself could be rendered useless, and probably destroyed, by

Fig. 4. Molten metal ladle

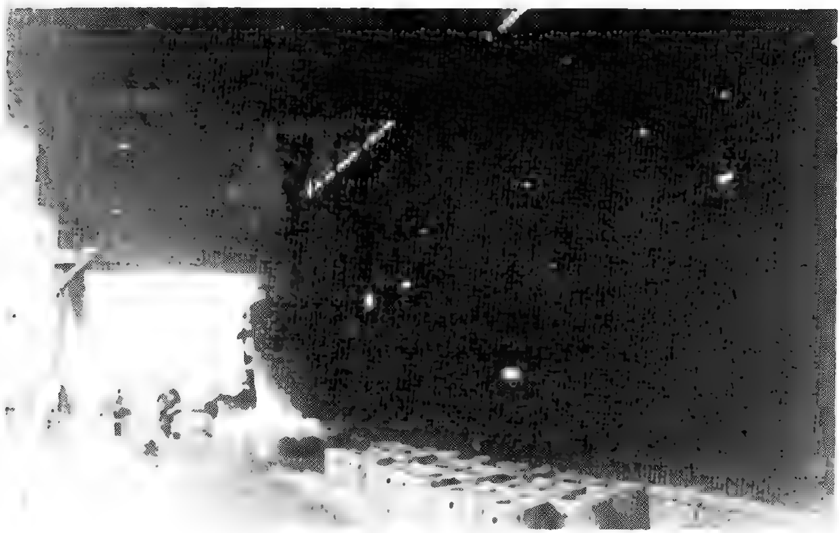


Fig. 5. Ladle, crane and molds

blowing it off its overhead track. If possible this should be done at a point wherein dropping, the crane would do the greatest amount of damage. The supporting track on one end could be severed by two necklace charges of TNT, properly placed at the area of crane support, or the crane may be dislodged from its track by wrapping a chain around the track on one end and setting the crane in motion toward the obstruction. If the rope escape ladder is not in the control cab, the demolisher operator should provide himself with some means of exit.

Fig. (b) The overhead crane should be blown from its tracks onto equipment below

11. The use of this very powerful overhead crane, in addition to swinging the heavy ladle, should also be considered for the tearing up of other heavy equipment within the area, or by pulling apart the furnace walls.

12. The blast furnaces can be readily located, as they are at the base of the largest and greatest number of stacks in the plant area, as shown in Fig. 6. The stacks are quite essential to the operation of a steel mill and if possible should be toppled over, preferably onto the furnace building. A large amount of explosives would be required, although the resulting damage would justify the explosive expenditure if it were available.

Fig. 6. Scrap yard and overhead cranes

13. Fig. 7 shows a closeup of the base of a typical reinforced concrete stack, and from it an idea can be gained of the damage that would occur,

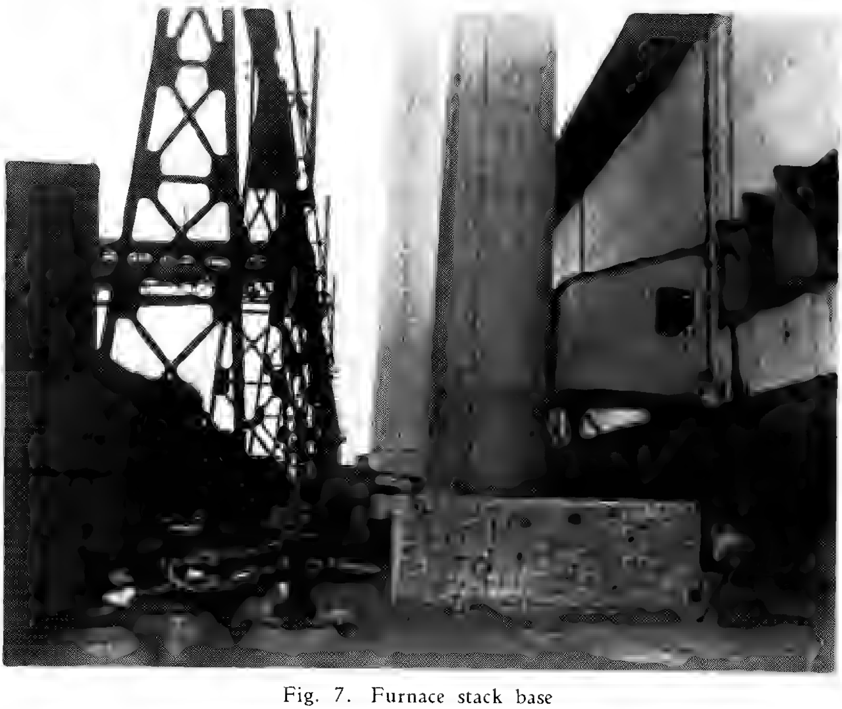


Fig. 7. Furnace stack base

Fig. (c) Blowers (right) and furnace (left) in Japanese steel foundry

should one of these stacks be felled across the furnace building at the right, and the other across the crane support at the left. In placing a charge of TNT on objects of this nature, it should be placed in a semi-circle on that side of the stack in which the direction of the fall is desired. To be most effective a charge must be backed with a heavy cover of mud or other suitable tamping material.

14. Fig. 6 in addition to showing the stacks of the blast furnace building, also shows the scrap yard and overhead crane system. These cranes should be either destroyed by dropping them from their supporting tracks, as they are not only useful in the handling of scrap metal to the furnaces, but also in the handling of many other heavy objects.

15. In steel mills, as in the case of all other industries, overhead cranes of large capacity should be destroyed wherever possible, and the destruction detail should make certain that all cranes are destroyed within a given plant area. If only one remains it will be of tremendous benefit to the personnel engaged in the reconstruction.

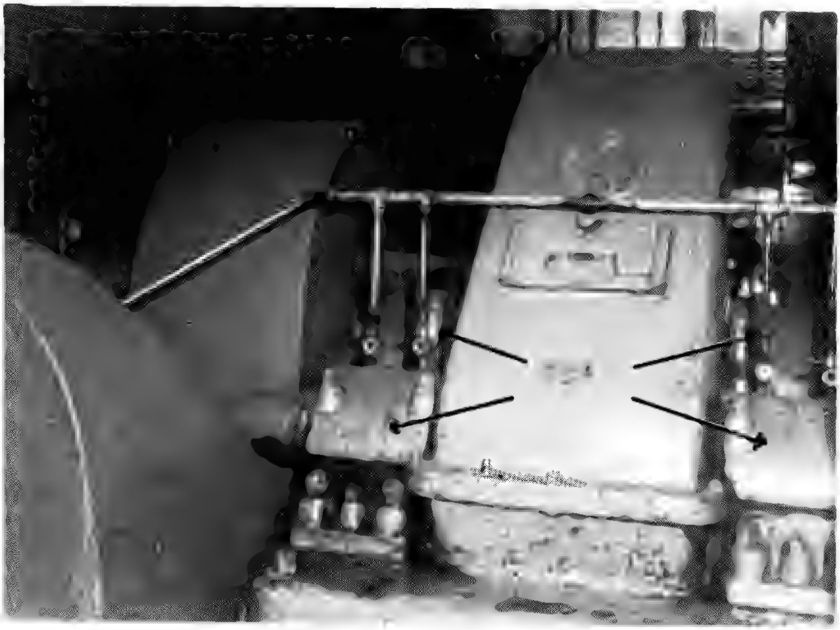


Fig. 8. Typical reduction gear

16. Most of the machinery used in the rolling, cutting or shaping of steel is extremely heavy and difficult to wreck. These machines generally depend upon substantial gear reductions to develop sufficient energy for their work, and, therefore, the gear mechanism, such as that shown in Fig. 8, should

Fig. (d) Giant hydraulic hammer forging steel

be the object of the destruction effort. Attention should be directed at the bearing areas indicated by the arrows in Fig. 8 and within the gears themselves. Access to the gear box can be accomplished by smashing the cover, or removing the inspection plate indicated in the illustration.

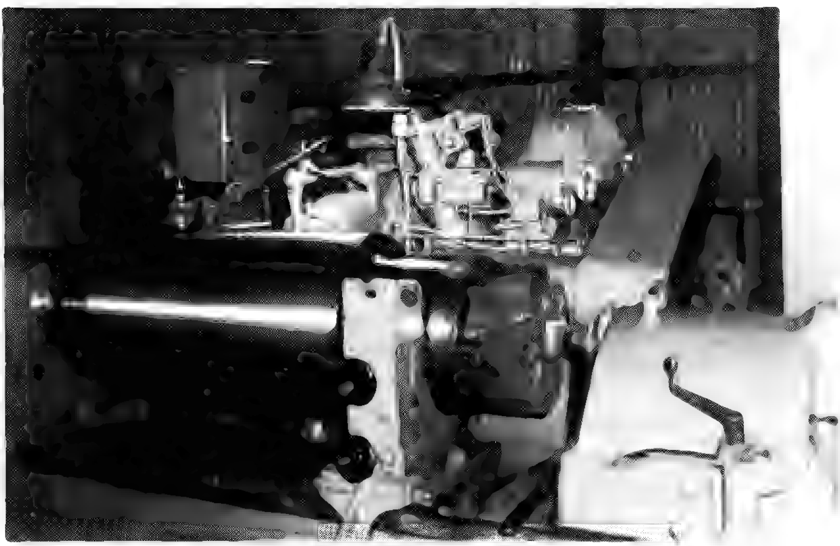


Fig. 9. Roller grinding machine

17. Thermite is probably of greater use, in destroying most of the heavy machinery within a steel mill, than explosives. All machines operate in some manner through shafts or pistons with large bearing surfaces, and it is here that the thermite should be placed and ignited.

18. A very successful job of destruction can usually be accomplished by inserting pieces of cold steel into the rollers and shapers while in motion.

19. Grinding machines similar to the one shown in Fig. 9, are used for the purpose of grinding and smoothing the surfaces of rollers and dies, and can be easily destroyed by the use of explosives or thermite. There will usually be one or more of these machines in use and always one or more spares nearby, or in the supply building, and it will be worth the effort to destroy them all. They are very difficult to replace as they are usually made to order and it might require several months to put this portion of the plant back into operation.

Fig. (e) Blowers and furnaces. Anshan. Japan steel foundry

20. In order to conserve both thermite and explosives, the detail should employ the method of throwing cold steel bars and iron blocks into gears and presses as much as possible.

21. Sulphuric acid is a necessity in a steel mill and normally one or more large supply tanks will be found in the area. The acid is usually contained in these tanks in its concentrated form, and when mixed with water becomes a very effective corrosive agent. The acid without mixing with water

has little or no corrosive effect but requires a proportion of 18% acid and 82% water, or approximately this proportion, for best results.

22. If time and other agents of destruction were limited, it would be well to pour this solution into as many gear boxes, bearing surfaces, etc., as possible before leaving. If allowed to remain in contact with the metal for only a matter of three or four hours, it will probably do such damage as to require replacement of the entire unit.

23. In mixing sulphuric acid and water it is well to remember that the water should *not* be poured into the acid, as a terrific explosion will usually occur. In mixing, the acid should be slowly poured down the side of the tank into the water. All who have anything to do with the handling of this acid or mixture are cautioned as to the serious effect produced by contact with the skin or clothing.

24. One very effective way of damaging heavy machinery is accomplished through destruction of the lubricating oil pressure system thereon, and then causing the machinery to continue in operation. Except for the external piping, the internal oil system is usually an integral part of a machine, and when destroyed or damaged requires rebuilding or replacing of substantial units.

25. Machines such as rollers, cutters and shapers operate normally at high speed, and under heavy load would ruin themselves within a few minutes if the pressure lubrication oil supply were cut off. For a steel mill in motion, and where the normal agents of destruction were not present, this would be the most effective method of damaging all of the smaller but important fabricating machines.

26. As in the case of most other industries, water is an essential item to operation, and the well-planned destructive mission will embrace steps to damage or destroy the water supply system. Where the water is supplied from outside sources such as a municipal main, this should be severed by explosives or thermite at the point of entry to the mill area. Search should be made for deep-well pumps which may be located within the area, and used either for primary water, or as a standby source, in the event of breakdown in the municipal system.

27. Fig. 10 illustrates a typical type of deep-well pump where the electric motor is situated on the upper end of a vertical shaft. This should and can be quickly destroyed by packing TNT into the arrow indicated area, which would effectively destroy the pump head and the motor; or a few rounds of small arms ammunition could be fired into the area indicated by the pencil.

Fig. 10. Deep well vertical water pump

Fig. (f) A steel mill in Chosen, Korea

28. In the power house will be found one or more large air compressors which furnish air throughout the plant area. Many of the machines, and some of the most important ones, are operated by compressed air and it becomes advisable to damage or destroy this unit. Standby units may be put in service within a few days time but if these are not available it may require a month or more to put this source of power back into operation. The methods of compressor destruction have been covered thoroughly in other sections of this manual. Fig. 11 illustrates a compressor in operation, which is an electrically-driven reciprocating type pump, with the compression tank shown across the upper portion of the figure.

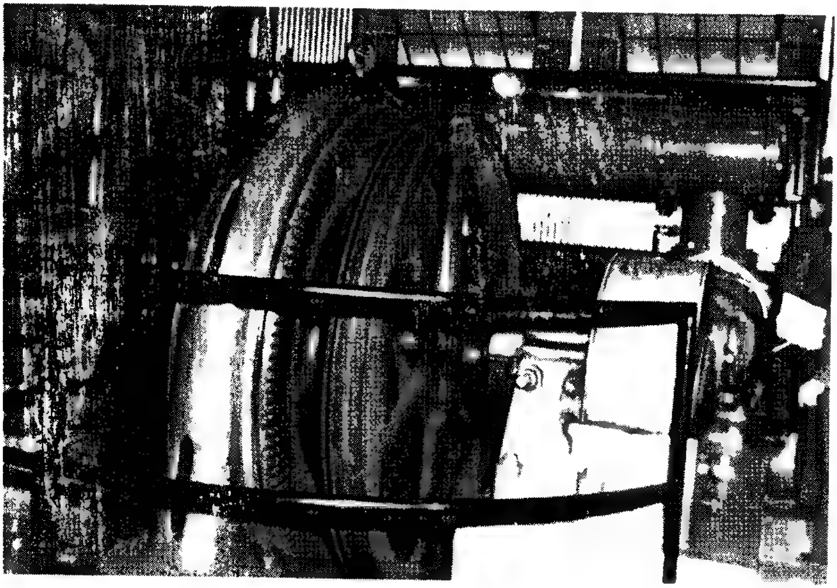


Fig. 11. Compressor motor and tank

29. The power plant of a steel mill is of course very vital to its operation, and the power requirement is usually sufficiently large to preclude the possibility of operation by any other than immensely large standby units. The power plant should be destroyed but not until just before departure, as the power is necessary to permit operation of the machines to their self-destruction.

30. The use of fire as a method of area destruction should be disregarded on a mission of this nature. There is very little within a steel mill area that is combustible, other than its fuel oil supply. For this reason, it is considered inadvisable to devote any time toward the destruction of the high pressure fire extinguishing system, or the stand pipes, unless considerable time is available and a complete job of destruction is desired.

STEEL INDUSTRY—AVIATION

31. A steel mill presents a very vulnerable target for air attack, as the heart of the target is confined into one area, and easily distinguished even with the most effective types of camouflage. This target is near the base of the usual row, or rows, of many stacks, and along the building to which they are attacked, as this is the furnace area.

32. Fig. 12 illustrates a steel mill showing all the essential activities necessary to the operation thereof. The RF of this photograph is 1″ equal 600′, and important details are easily distinguished. T-1 indicates the target of first importance, as it contains the blast furnaces. Hits obtained in this area would probably put most of the plant out of production until a number of furnaces were rebuilt.

Fig. 12. Vertical view of a steel mill

33. Unless general confusion is desired, there is little object in dropping bomb loads at any other target of a steel mill than that indicated above.

34. T-2 indicates the power house which is the target of second importance, and T-3 obviously indicates the fuel supply. As has been pointed out elsewhere on this manual, little damage would be occasioned by a direct hit upon this fuel tank other than the possible ignition of the contents. Any bombing should be directed at the point indicated by the arrow. This is obviously a steel or reinforced concrete tank depressed into the top of a constructed mound which gives both elevation and strength to the receptacle, and must be breached before the destructive effect of the burning oil could reach the mill area.

Fig. 13. Vertical view of a steel mill

35. Fig. 13 illustrates another steel mill where the RF is 1" equal 1667'. The area over which the buildings are scattered represents approximately 400 acres which obviously would require a tremendous amount of time and explosives to destroy. The heart of this plant is indicated by T-1, which is the blast furnace section, and as has been stated elsewhere herein, hits upon this building would have the effect of stopping production in the entire plant until the furnaces could be rebuilt.

AIRCRAFT INDUSTRY

1. Modern airplane plants engaged in the production of war planes, wherever located, are built and operated essentially upon the same basic principals. Whether the plant builds horioznatal or dive bombers, transports, torpedo, observation or fighter planes, the machinery used and methods of production and assembly are the same. Generally most airplane plants are of comparatively recent design and construction, and such variation as may exist will be found principaly in the methods of assembly.

2. As is the case with most other industries, the power plant is probably the most vulnerable and valuable single unit in the production chain. Destruction of this unit will not always tie up the plant, however, as facilities are usually available either to cut in standby power systems of their own, or tie into a metropolitan grid system. However, if time is limited, more damage could probably be caused by destroying the power plant than any other single unit. This subject will be discussed at greater length at the end of this chapter.

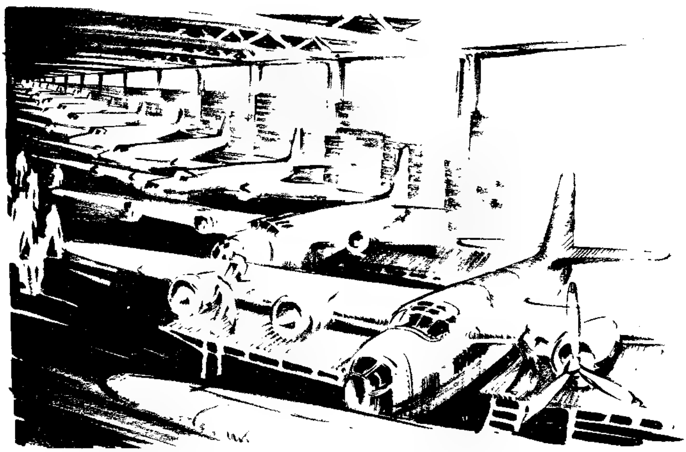


Fig. (a) Airplane assembly is usually contained in the largest buildings

3. Ordinarily each separate building contains one or more major operations in plane production, and will have its own independent sets of transformers. In the more modern type of buildings, those constructed within the past two or three years, these transformers will usually be contained in underground vaults, under the building they serve, where they are more difficult to reach than those situated on the outside.

4. Fig. 1 shows a typical recent transformer installation in a vault, and Fig. 2 shows the type of outside construction that may be found in most plants more than three years old, and where this vulnerable target has not been placed in a less hazardous location. Naturally outside transformers in a critical zone will be sandbagged or bulkheaded to minimize the danger of a hit from aerial bombing.

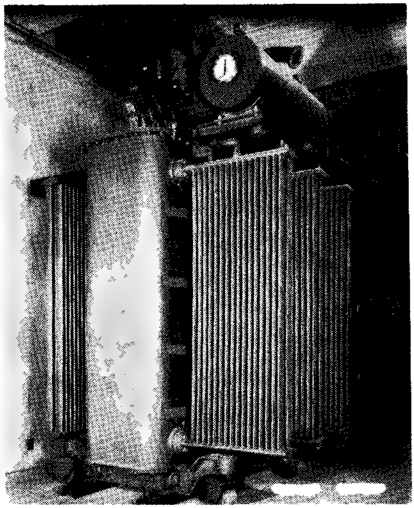


Fig. 1. Step-down transformer in underground vault

5. The surface detail should destroy these transformer installations, particularly in the principal buildings, if time permits. These can be quickly destroyed by placing a charge of TNT directly under the bottom of the transformers, in the area indicated by an arrow in Figs. 1 and 2. Charges detonated here would breach the casing and ruin the windings on the inside of the transformers, as well as release the cooling oil therein. Unless this oil were of a comparatively new non-inflammable type, it could be ignited, and the resulting fire would completely ruin the remainder of the transformers and the wiring system.

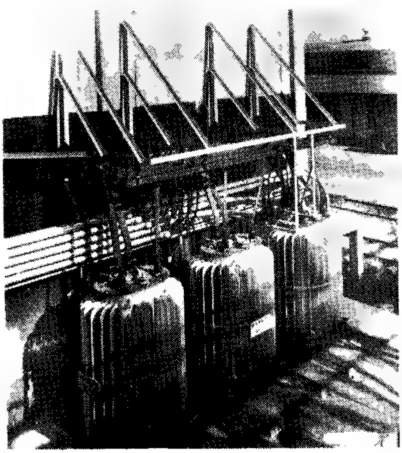


Fig. 2. Transformer in exposed position

6. An additional excellent method of destroying, would be to ignite a small charge of thermite on the cover, as it would burn through the case and into the windings. However, the destruction detail should be aware of the high voltage existing at the top of the transformers where the lead-ins appear, and avoid all contact with the terminals while placing and igniting the thermite.

7. Transformers may also be ruined by firing a few shots through the main body to disrupt the windings, and either fire through the cooling fins or demolish them with explosives.

8. Fire is not normally a medium of large scale destruction in an aircraft plant, due to their general fireproof construction; presence of adequate sprinkler systems; and the comparative absence of inflammable materials in the manufacturing process.

9. Some sections are, however, vulnerable to fire and these should be located and fires started. Among the most important are the pattern shop, the sheet aluminum store room, motor and propeller store room, or areas; paint shop, carpenter shop, and drafting room. The contents of the rooms named above are usually quite inflammable and fires can be very easily started therein. In the drafting room and pattern shop, fires would be particularly destructive as they would certainly destroy existing blue prints, patterns, and plans of planes in the process of construction. However, master copies of each past and present plane, and part, is contained in a heavy constructed fireproof vault, usually located in the administration building.

10. The sheet aluminum will under favorable circumstances ignite and burn at extremely high heat and with a fire that is difficult to extinguish.

11. Usually each airplane yard will have a scrap pile in which all borings, clippings, and cuttings of waste size are thrown and later sorted. Most of these materials can be ignited by a common thermite bomb, and the intense heat from such a fire would ignite most inflammable objects within several hundred feet.

12. In most modern airplane plants, especially under wartime production requirements, space is extremely limited and units like motors and propellers are left in their original packing cases and stored in some open area. The plan should definitely include the setting on fire of these cases, as a tremendous amount of destruction could be done in a short period of time in this manner. Thermite and petroleum products should be used liberally in the starting of these fires, and material from the scrap pile above referred to, should be thrown into the fire area, particularly aluminum borings, of which a large pile or bin will usually be found in the scrap area.

13. Most aircraft plants have a rather large and well-equipped paint shop, separated from the remainder of the building. Most of the chemicals used in airplane paint mixing are combustible or inflammable when subjected to sufficient heat, and are very difficult to extinguish unless foamite or some smothering chemical extinguisher is used. Water only succeeds in scattering

the burning particles; so before the fire is started all special fire extinguishers in the paint shop should be smashed, turned on, or upside down, outside the shop.

14. The drums of paint, turpentine, and other chemicals to be found in the paint shop, could be easily rolled to other sections of the factory for the purpose of starting fires, if time permits. Most paint shops will contain a number of drums of cyanide which is especially dangerous to handle; and those engaged on the destruction detail should expose their respiratory systems only to those chemicals easily identified. Were it not for the rules of international warfare prohibiting the use of gas, the contents of one 50 gallon drum of cyanide could be poured into the ventilating, or air conditioning system, and dispose of all the occupants within a short period of time.

15. In all other destruction duties in an airplane plant, the members of the detail could normally function without their gas masks, but when entering or working in the paint shops, they should do so only after the masks have been adjusted.

16. Within the area of most airplane plants will be found a Butane tank which contains an auxiliary source of fuel. Fig. 3 illustrates two of these tanks in position, as part of the equipment of a modern aircraft factory, but separated from the principal factory area by considerable distance.

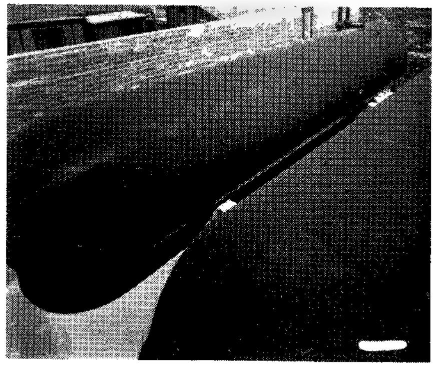


Fig. 3. Butane tanks, showing relief valves

17. Fig. 4 shows the generating set in the foreground, and the brick wall housing the two Butane tanks in the middle background. The two sets of expanison valve pipes are seen rising above the tank enclosure. Fig. 5 is a closeup of the detail of the gas generator.

18. As has been explained and illustrated elsewhere in this manual, this gas is highly explosive, and the two tanks shown in the figures are capable, upon exploding, to level practically all plant buildings, which may be within two or three hundred yards away.

19. To destroy the two tanks shown herein by a surface attack, thermite should be placed on the top of the tank and at an end where the sphere

Fig. 4. Butane generator with tank enclosure in background

Fig. 5. Closeup of butane generator

begins, as here the metal is only half as thick as on the straight surface. When the thermite had burned sufficiently through to release the pressure, escaping gas would be ignited with a terrific explosion.

20. Should no thermite be available, a charge of TNT could be detonated on the end of the tank, or a hole could be knocked through the brick wall opposite one end of a tank, and rifle fire directed into the tank from a distant protected position. Some form of spark would be needed to ignite the escaping gas, unless it were present in the explosion, and this could be supplied by tracer fire. The destruction of this generator and tank arrangement should be done only after the other destructive portions of the plan have been completed.

21. As in the case of all other industries where fire is to be employed as a principal agent of destruction, the automatic sprinkler system, and other units of the fire protection or fire fighting system, should be destroyed before the fire is set. The method of doing this has been covered elsewhere in this manual, and it is considered unnecessary to repeat here.

22. Usually a number of large separate buildings will house the various parts room, and special types of machines, with the largest of the buildings being used for the actual assembly of the planes Within these separate buildings will be found the more vulnerable machinery, and here the greatest amount of damage to the plane production capacity could be accomplished, by well-planned destructive efforts.

23. Fig. 6 illustrates a large press used in the bending of metal plates. This should be easily destroyed by the application of thermite or explosives to the hydraulic pistons, which may be clearly seen in the figure. Before applying the thermite, the head of the press should be extended as far as possible, as in this position the greatest amount of damage would be done to the pistons and hydraulic cylinders. Entry into the head of the press, which is gained through the aperture shown at the top of the ladder. exposes the intricate piping and control mechanism, where considerable damage could be done. How-

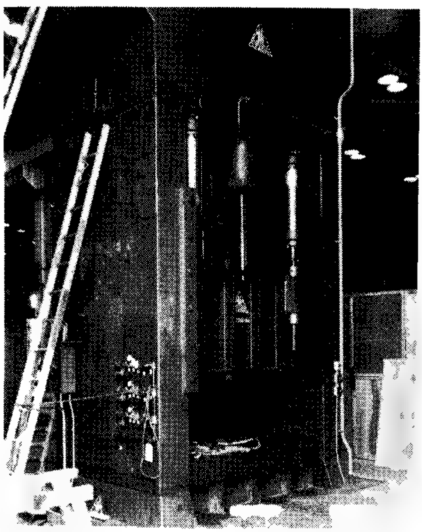


Fig. 6. Hydraulic press

ever, this machine could be put out of service for a period of two or three months through the application of thermite or explosives to the exposed cylinders and pistons.

24. Fig. 7 illustrates an enormous hydraulic press, of which the most modern plant would probably have only one, which is a key to the heart of all plant activity. One stroke of the hydraulic piston produces many intricate stampings on six separate die tables, and even minor damage to this machine would temporarily put it out of commission, and have a serious effect upon the remainder of the plant production.

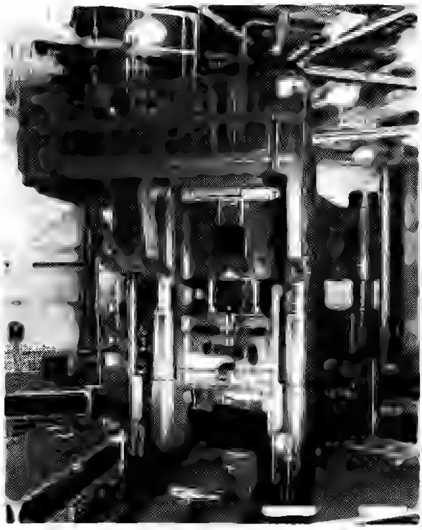


Fig. 7. Six platform hydraulic press

Fig. 8. Closeup of hydro-press top

25. The press is so heavily constructed that there is little about it to be damaged, except by major explosive charges. Thermite is the best agent of destruction and should be applied on the main cylinder and piston area, as indicated by arrow in Fig. 7. Fig. 8 illustrates the top of the press and an additional thermite charge should be placed on

the two vertical pistons, indicated by arrows, and on the center of the top of the machine. Effort should be made to place thermite on each of the exposed piston surfaces, in order to destroy both the piston, and to fuse the metal thereof with the hydraulic cylinder.

26. Fig. 9 illustrates another type of press, of which the average modern plant would have probably three or four in operation, and one spare. This press should be destroyed by throwing steel bars into the gears at the top of the press and then starting the press in motion; afterwards applying thermite at all shaft and bearing junctions.

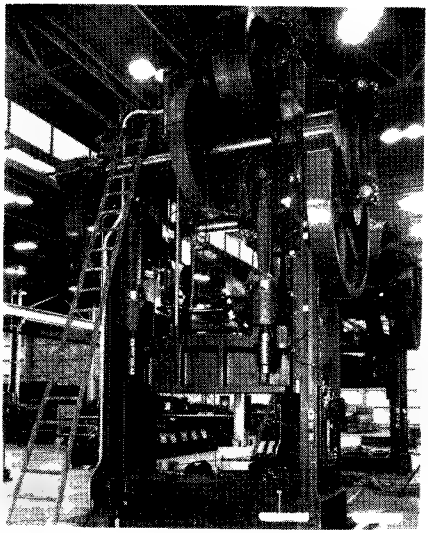


Fig. 9. Geared press

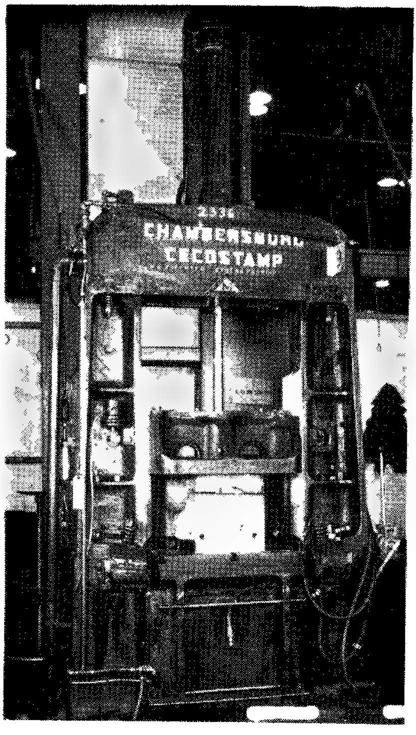


Fig. 10. Hydraulic hammer

27. The same type of treatment should be accorded the hammer shown in Fig. 10. This is a hydraulic hammer of which a large plant will have ten or twelve in operation. Fig. 11 is a closeup of the top of this hammer showing the hydraulic cylinder with its oil feed line. The heavy frame construction of the hammer makes it obvious that destructive effort should be directed toward the piston and cylinder assembly.

28. Figs. 12 and 13 show the overall and closeup arrangement of a bending machine, which is very important in aircraft production, and is one of probably two or three contained in the average big plant. This machine is hydraulically operated and subject to the same destructive influences as has been described for other machines of this nature.

29. The figures which have been discussed heretofore all suggest massiveness, and indicate the care and understanding required for effective destruction. Another means to assist in the destruction of presses would be to set a mold to one side of the bed so that the pressure will clear but the accompanying block will not. Now when the press is lowered so that the block catches on the mold, the pressure will continue on down, by-passing the block. This will wreck the gears and shaft arrangements at the top of the press, and would require several months to repair.

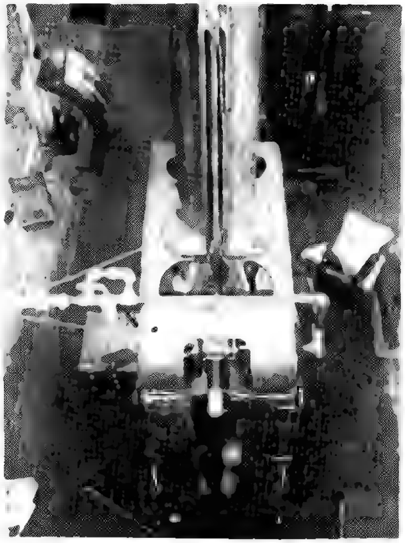


Fig. 11. Top construction of hydraulic hammer

30. It is repeated again that the throwing of blocks of steel or tools

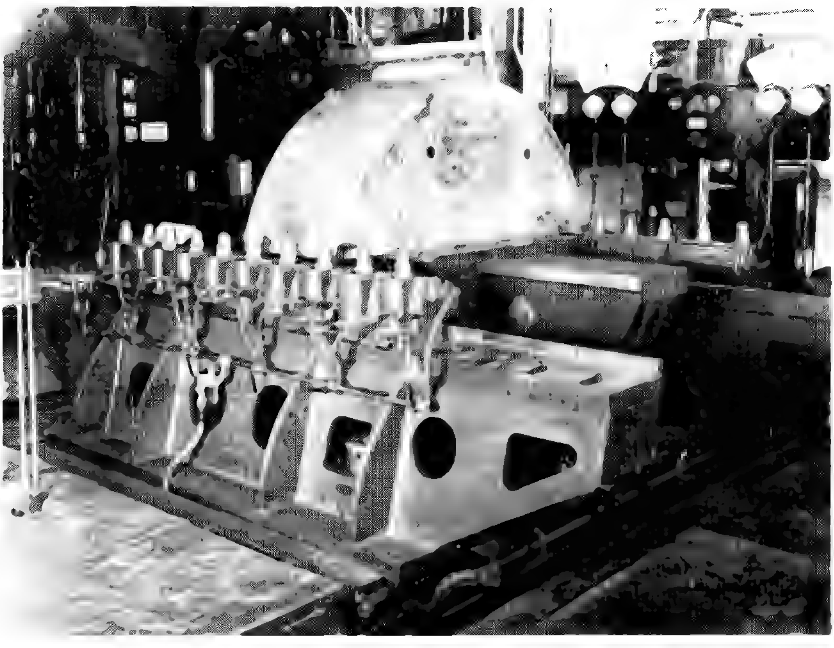


Fig. 12. Overall view of bending machine

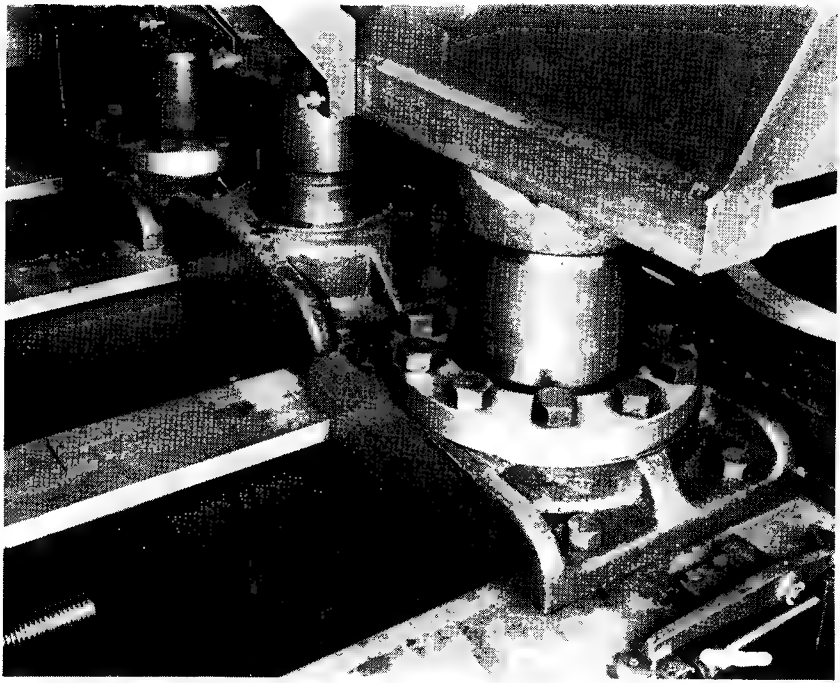


Fig. 13. Closeup of bending machine

into the gears of these machines, while in operation, is probably one of the fastest and simplest ways of destroying their moving parts. TNT can be used to sheer the smaller link rods and pins (Fig. 14) of the presses.

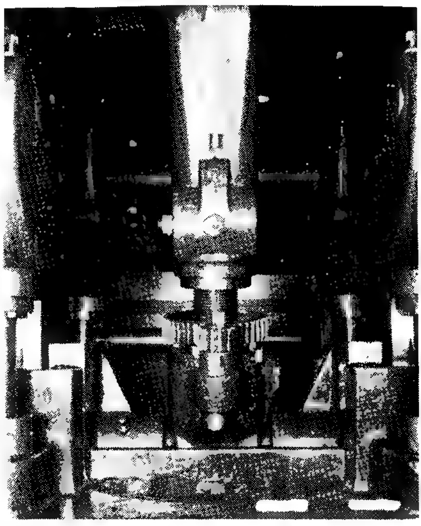


Fig. 14. Detail of press gear and pin construction

31. One section of the plant will be devoted to the nitrate heating rooms and kettles, of which several units are shown in Figs. 15, 16, and 17. These units are in constant use and are necessary, but if destroyed could be replaced within four or five days. Unless a very complete stage of destruction is planned, it is considered inadvisable to devote much time to this equipment.

32. Each modern plant will contain a rather elaborate communicating system, of which a few illustrations are shown. Fig. 18 shows the terminal strips, similar to those illustrated in the chapter of this manual dealing with telephone communications, and these may be destroyed in the same manner indicated therein. It is important to put the communication system out of operation early in the effort, and therefore men should be detailed for this purpose. The board and all principal equipment will usually be found in the administration building.

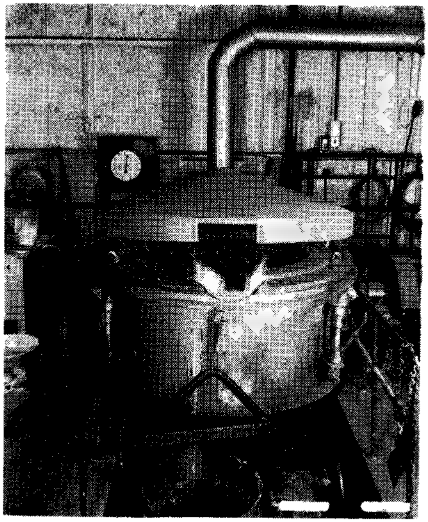


Fig. 15. Nitrate kettle

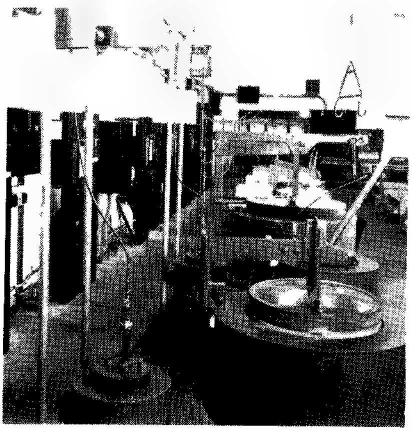


Fig. 16. Nitrate heating room

33. Fig 19 shows the switchboard relay arrangement, and Fig. 20 shows the teletype machines, which will normally be found in the massage or communication center. While it is considered of no advantage to demolish the switchboard shown in Fig. 21, the lead-in wires appearing at the upper left should be severed, which can be accomplished rather quickly with an axe, explosives, or incendiaries. Water, acid, or fire extinguisher contents should be sprayed on the back side of the switchboard, as well as on the wiring in the relay and terminal

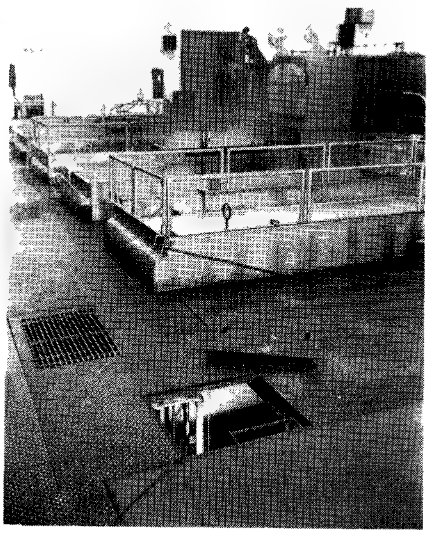


Fig. 17. Nitrate tanks and manhole

strip rooms, which will be adjacent thereto. The switchboard operating batteries, and generator with stand-by, are shown in Figs. 22 and 23, and these both should and can be quickly destroyed.

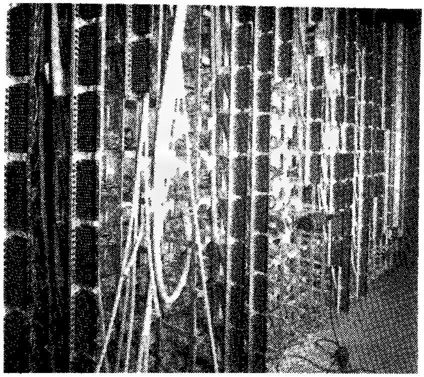


Fig. 18. Switchboard terminal strip wiring

34. Fig. 24 shows a typical plant protection switchboard, which usually will be located at guard headquarters, in or near the administration building. On this board is centered all of the signal apparatus emanating from various parts of the plant, as well as a control of all guard telephone lines; and automatic connections with district police, and fire departments, and with military headquarters, when certain types of alarms are sounded. Here also are the controls for the plant loudspeaker system. This entire board obviously should be destroyed early in the main effort, and this is quickly accomplished by attacking it at the back with a sledge or heavy club, where the various terminals converge.

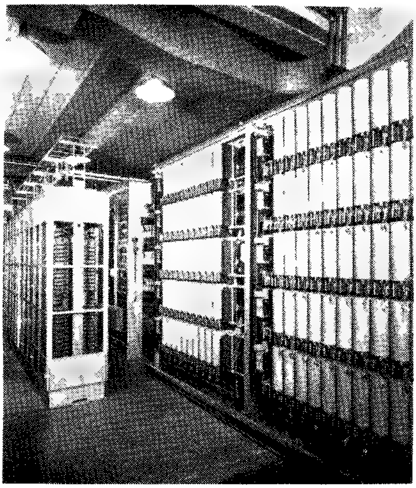


Fig. 19. Switchboard relays

35. The heat treating furnaces (Fig. 25) are very important to the construction of airplanes, and should be destroyed. These furnaces are strongly built of a brick interlining and sheet steel covering. When in operation they are very hot and can be breached only by charges on the outside, but when cold the destructive effort should come from within. The control panel shown on the left of Fig. 25 should be demolished also. The destruction of these furnaces is considered of

Fig. 20. Teletype machines

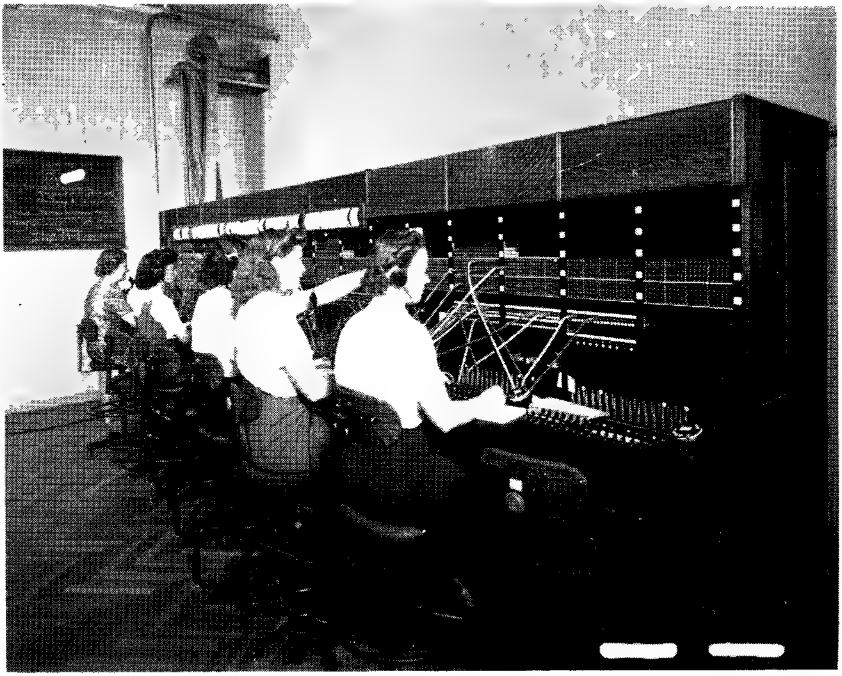


Fig. 21. Plant switchboard

equal importance to the various other machines heretofore described.

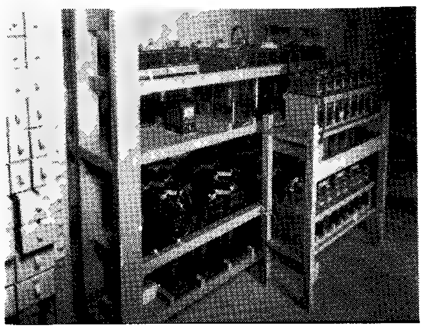


Fig. 22. Switchboard batteries

36. The average plant will have a number of large storage tanks, containing aviation gasoline, which are used for the fueling of planes as they come off the assembly line for test. These tanks may be either exposed or buried, but will usually be close to the main assembly buildings. They usually operate by a power mechanical pump, and if possible this pump should be started in motion and a large amount of gasoline pumped out, and if possible, into the adjacent buildings. If this were done before ignition, a fire of very serious consequences to buildings and nearby planes would occur.

37. As discussed in other chapters, when the plan embraces the widespread use of fire, smothering or chemical types of fire extinguishers of

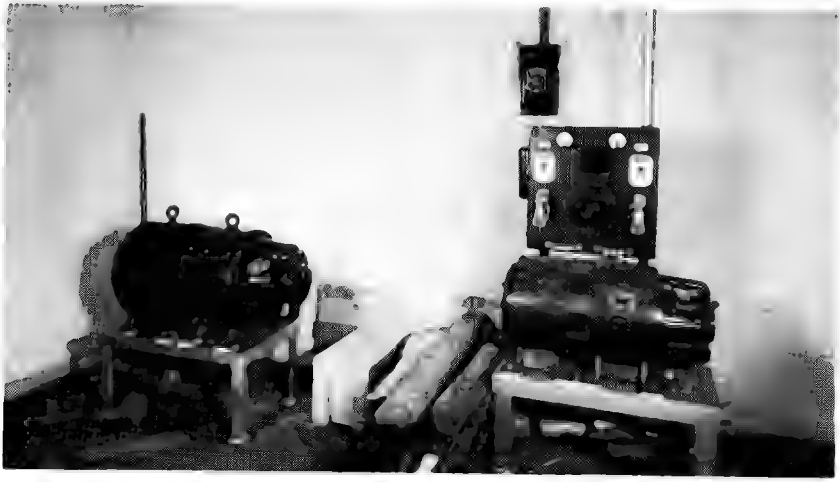


Fig. 23. Switchboard generator and spare

larger capacity, and the plant fire station, should always be destroyed early in the effort.

38. The power supply of an aircraft plant is probably the most important single unit, or installation, to its continued operation. Within the power

Fig. 24 Plant protection switchboard

Fig. 25. Lindberg heat treating furnaces and control board

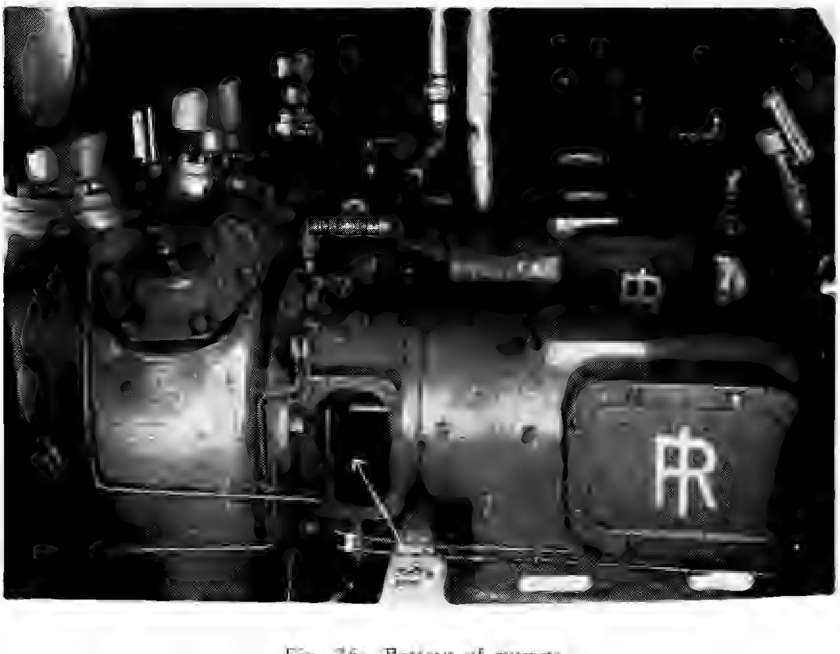


Fig. 26. Battery of pumps

house will usually be found the typical installations of pumps, as illustrated in Fig. 26. These are of a steam-driven-reciprocating type and could be effectively destroyed by placing an explosive charge in the aperture, indicated by an arrow, between the steam chest and the pump cylinder.

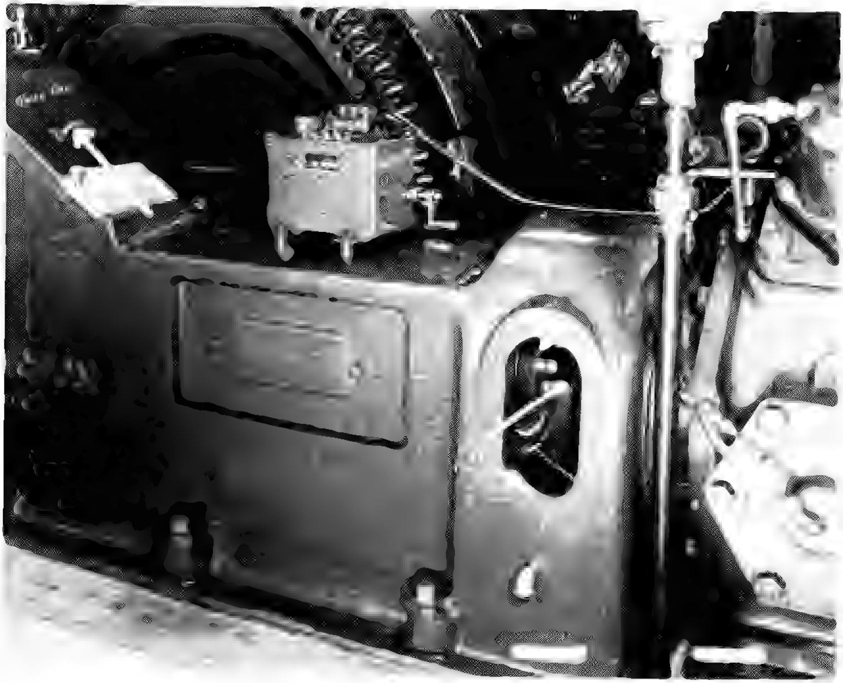


Fig. 27. Generator, piston and steam chest

39. Fig. 27 illustrates a geared reciprocating type electrical generator, with steam chest and piston visible in the right foreground. The handle at the top left opens the gear case cover, where, by dropping a few steel bars or tools, the gear mechanism could be effectively destroyed.

40. The conventional type of steam-electric turbine is illustrated in Fig. 28, and the method of destruction has been discussed in other chapters of this manual, so that it is considered unnecessary to repeat here. Attention is invited, however, to the generator inspection windows which are useful in inserting a block of TNT to damage the windings and short the circuit, and also the principal generator bearing in the right center, which could be effectively destroyed with thermite.

41. Figs. 29 and 30 illustrate two typical types of pump installations which will normally be found in the power house, and which are vital to continued production. Fig. 29 is a small steam turbine turning a centrifugal

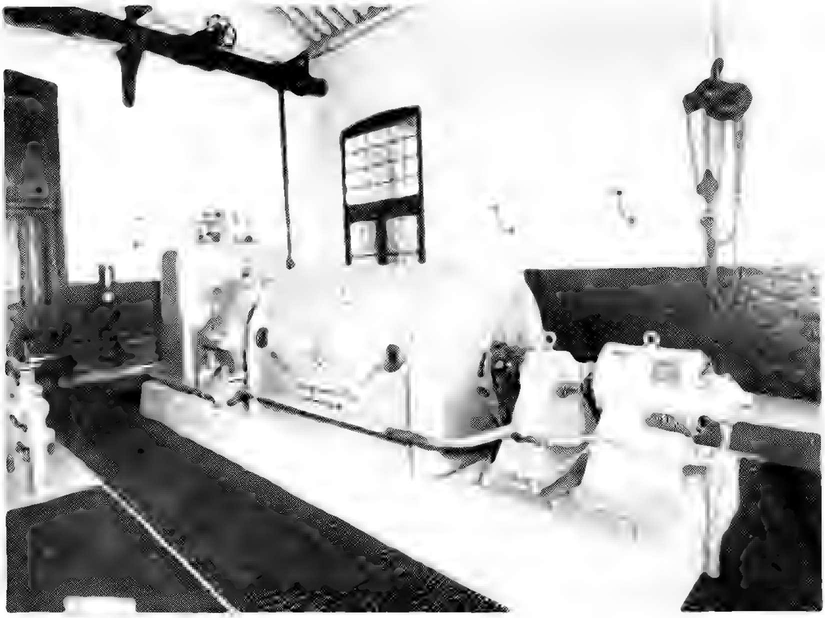


Fig. 28. Steam turbo-generator

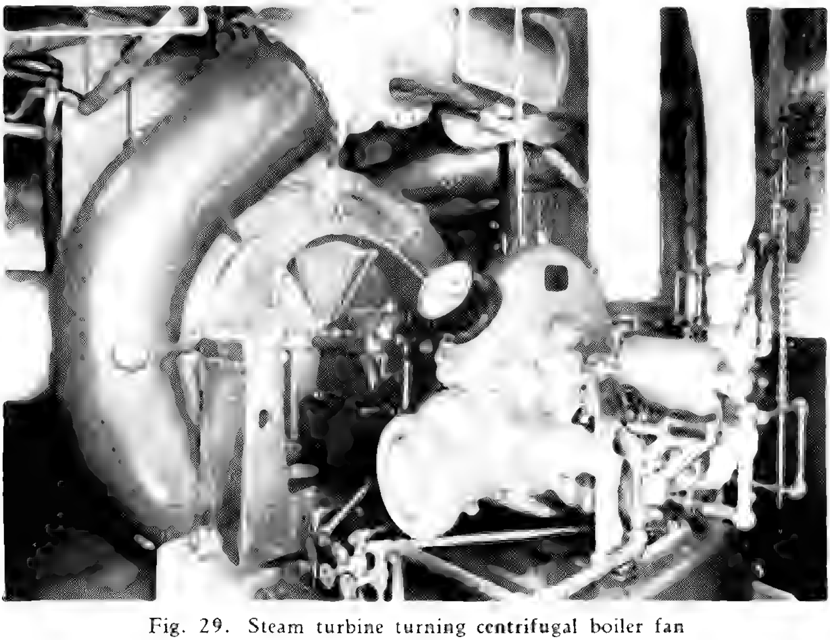


Fig. 29. Steam turbine turning centrifugal boiler fan

pump furnishing air to the boilers, and Fig. 30 the same type of steam turbine supplying boiler fuel under pressure.

42. Opportunity to study the over-speed trip mechanism of a small turbine is presented in Fig. 30. This unit is appropriately indicated and in order to permit the turbine to destroy itself by excessive speeds, the throttle valve on the steam line should be opened full width, and the over-speed trip lever handle wired, or otherwise secured, in its present position. With the load removed from the pump by closing the oil line valve directly in front of the two wall guages, the turbine will quickly build up its speed to a point of self-destruction.

43. The destruction of the power supply should be left until one of the last acts before leaving the plant area. Elsewhere in this chapter has been discussed the great many uses to which the continual flow of power can be put in the destruction of most of the critical equipment in an aircraft factory.

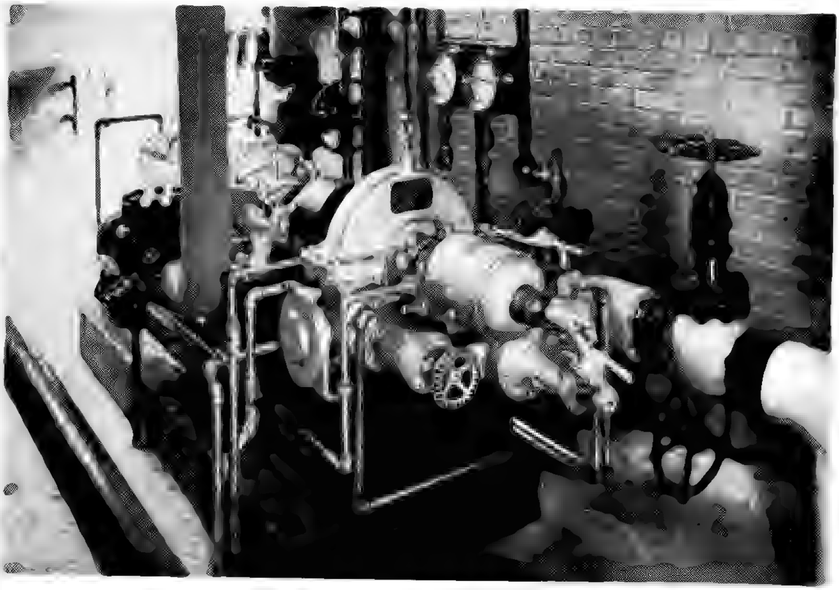


Fig. 30. Steam turbine turning fuel pump

RAILROADS

1. The most important link in the transportation system of any country on the home-front is that of railroads, and the uninterrupted use of these facilities is vital to the war effort of that nation. Other means of transportation are generally available in the event of a break-down of the railroad system, such as, trucks and coast-wise or inland water-way boats, but disruption of the railroad system will normally retard the war effort to a very substantial degree until service is restored.

2. The task of destruction of a railroad transportation system is enormous, in view of the wide area over which it is distributed and the tremendous amount of rolling stock which it employs. It becomes necessary therefore to know where and what normally constitutes the heart of the transportation system, in order that effective blows may be delivered at that point.

3. Railroad shops are generally considered the most critical portion of a railroad system. In these maintenance shops, usually located in a large terminal area, will be found repair shops of all sorts for freight and passenger cars, and the roundhouse for the repair and maintenance of engines. These comprise the very heart of a railroad transportation system. The object that should receive the first attention of a demolition crew is the turntable at the roundhouse. Fig. 1 shows a typical maintenance yard area and indicates the relationship of the roundhouse to the car repair shops.

4. Due to the constantly changing appearance of the yards, through the movement of cars in and out, it is difficult to camouflage, or otherwise conceal, this type of a target from the air, and of course they are easily located by surface forces.

5. Railroads are entirely dependent upon their locomotive power and these engines are subjected to frequent periodic inspection and overhauling. The roundhouse is the place where this is done because only there the required equipment is maintained, and the turntable is necessary to shuttle the locomotives into the roundhouse stalls. Fig. 2 shows a locomotive on a turntable, upon its being removed from the roundhouse. These turntables are electrically controlled by rheostat controls located in the operator's house at one end. For ground forces the best method to destroy the turntable is to turn the same so that the matching rails are approximately four inches off

Fig. 1. Roundhouse and car repair yards

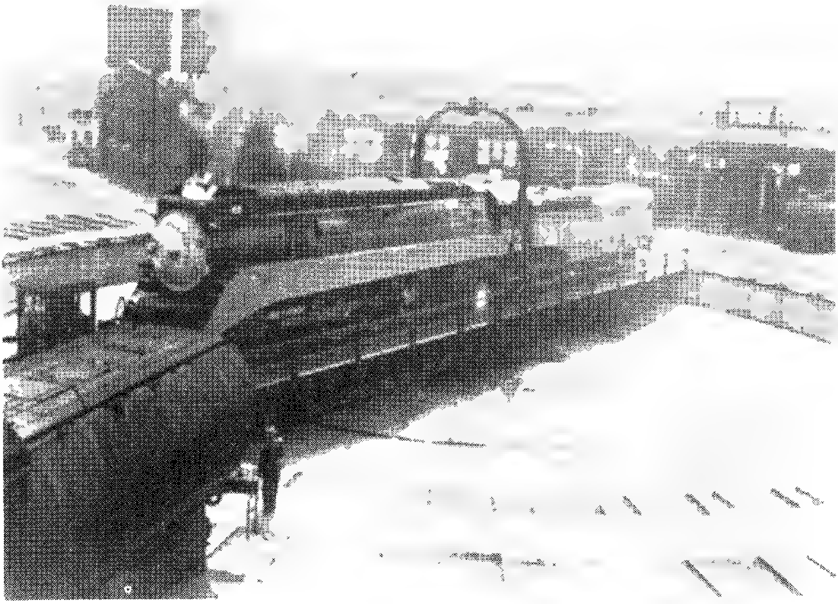


Fig. 2. Locomotive on turntable

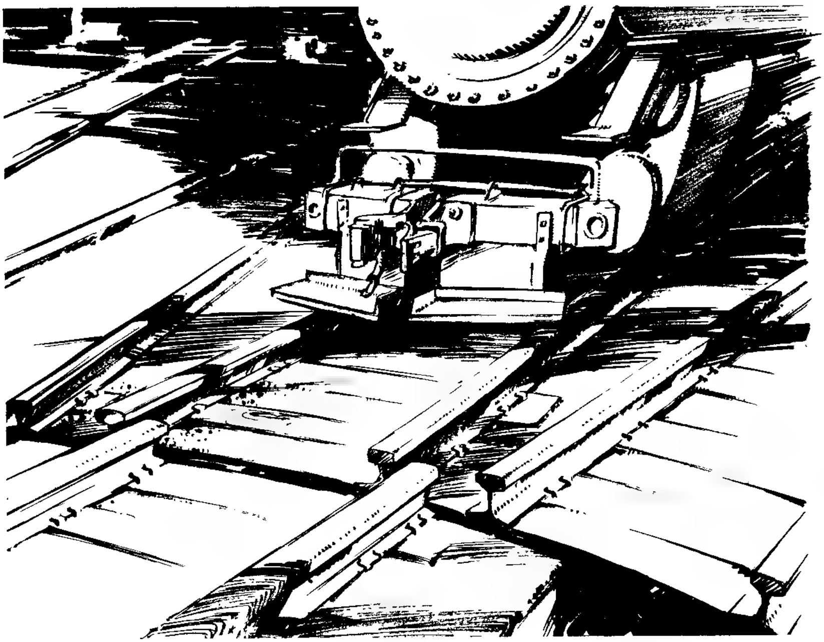


Fig. (a) Detail of offset in tracks

center, lock the turntable in this position, and then run a locomotive with steam up onto the turntable. The heaviest locomotive available should be used, and it should be headed forward onto the turntable. The enormous weight of the locomotive off center will tip the turntable over and topple the locomotive into the turntable recess, and this will very effectively wreck both. If the tender is filled with oil and has not been breached by the wrecking, this should be done by opening the filling cap normally located on the top of the locomotive tender. The remaining fire in the locomotive firebox will normally be sufficient to ignite this released oil from the tender.

Fig. (b) Locomotive should be run onto off-center turntable

6. If other locomotives are in running condition in the roundhouse, all of these should be set in motion toward the turntable recess. Effort should even be made to pull or push cold locomotives into the recess through the use of block and tackle, or a switch engine, which will usually be found in the immediate vicinity.

7. All tender or tank cars in the immediate vicinity of the roundhouse should be opened and their contents allowed to spread over the area. A crew of twenty skilled men, working free from molestation for a period of thirty minutes in a roundhouse area, can effectively, in the manner described above, put a substantial portion of the existing locomotive equip-

ment out of action for an indefinite period of time, and will render the repair facilities useless for a period of from two to four months.

8. In the event that only one locomotive with sufficient steam for operating is available, it would be advisable to destroy the turntable with explosives and use the power of the engine for other destructive work. Turntables are built around a large central pivot, with special truck wheels on the tracks around the edge. The explosives should be placed against these three points and all three charges should be against one side in order to utilize the fullest effective force of the explosion.

9. One of the first things to commandeer is a locomotive in operation, as this will be found to be extremely helpful in various phases of destruction. It can be used to pull up machinery from its bed, pull down buildings and water towers, rip up tracks and switches, and upon completion of the mission, might be used to aid in the escape. Fig. 3 shows the typical control levers in a locomotive cab. These will be found on the right hand side facing forward, and if the regular crew canot be forced to operate the locomotive, it can easily be operated by the demolition detail. The forward and reverse lever is indicated by (a) in Fig. 3, and this lever is usually placed in the direction in which the locomotive is to travel. The air control lever in the center foreground usually controls the air brakes on the entire train should other cars be attached. This lever must be released until the familiar sigh of the released air is heard. The air control lever in the middle foreground controls the air brakes in the engine itself, and will usually be the only one required in the stopping and starting of the engine. In the upper left, between the three dials, will be found the throttle which controls the steam, and consequently the movement of the engine. In the picture it is shown in the off position.

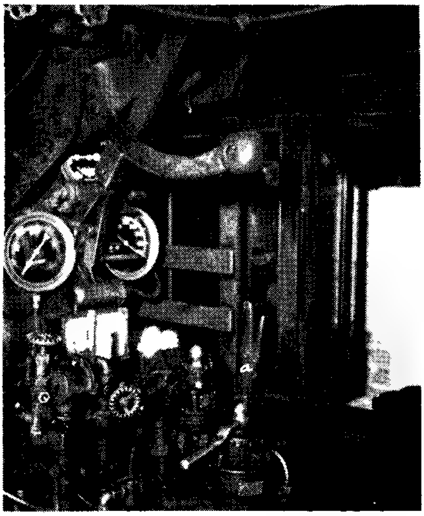


Fig. 3. Engine controls in cab

10. Generally in the yards immediately adjacent to the roundhouse, will be found the wrecking crane. Usually each railroad division stations one of these in the shop area except when it is in actual use. This huge crane is very necessary to heavy repair work and if placed out of commission

would have to be rebuilt before repair work of this nature could be resumed. This crane is used on all types of heavier work, such as clearing tracks of train wrecks, repairing wrecked trestles and bridges, and other such similar type of work. This crane usually has steam up to near operating pressure, and will be invaluable in the destruction of many installations in the yard. The controls are relatively simple, and its force is sufficient to topple over water towers, oil tanks and other heavy permanent types of installations. When this crane has fulfilled its purpose of destruction, it should be destroyed by setting it in motion toward the turntable recess, or downgrade on a section of mainline track. Before placing it in motion, however, winches and gears should be first destroyed with thermite or explosives.

11. Within the shops themselves will be found a great deal of machinery that should and can easily be destroyed if time permits. These machines consist principally of lathes, as shown in Fig. 4, shapers, presses, machines, drills, etc. This equipment is all exceptionally heavily built and can

Fig 4. Lathe

be destroyed only with the liberal use of explosives or incendiaries. Probably the most effective way for quick destruction is to throw steel bars or tools into moving gears, as this would probably require complete replacement of specially machined gears, and in many cases, the entire machine would be thrown out of line by the action.

12. In considering the destruction of machines or facilities, it should always be attempted to destroy the same piece of machinery, in order that interchange of similar parts would thereby be impossible.

13. When destroying machinery, if possible, it is also advisable to blow or tear the machines from their base or bed. In many cases the base may

require more time to replace, than the replacement of the machine itself.

14. In every railroad shop, and close to the principal machine shops and the roundhouse, will be found a blacksmith shop and foundry. If time permits it is worth the effort to gather up the cutting tools from the shaping machines and lathes, and deposit them in a forge or furnace, as shown in Fig. 5. These cutting tools are difficult to replace and the forge will destroy their usefulness.

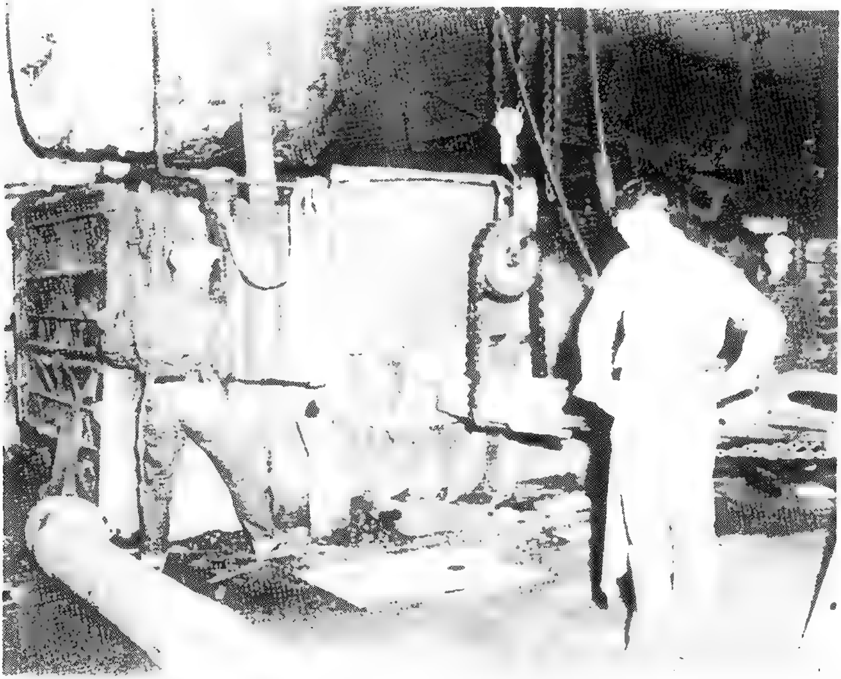


Fig. 5. Furnace

15. Every large railroad machine shop, especially that building in which boilers are repaired and overhauled, has several overhead cranes, such as shown in Fig. 6. These cranes are very essential to repair work and if destroyed must be rebuilt before other work can proceed. These overhead cranes are very easily blown from the tracks onto the equipment below, destroying itself and such machinery as may be thereunder.

16. Fig. 7 shows a particularly large crane of 200 tons capacity, the destruction of which would completely immobilize the shop in which it is located for a period of thirty to sixty days. These cranes should be used to destroy the machinery and equipment in the building before being dropped themselves. The best way to accomplish this would be to attach

Fig. 6. Boiler repair shop with overhead crane

Fig. 7. 200 ton crane in engine repair shop

the crane by cables or heavy chains around either end of a locomotive at one end of the building, and then drag the captive locomotive broadside down the length of the building. The operating mechanism of these cranes is rather simple, and can easily be determined through the trial and error method. In this connection it is noted that the power supply of the shop area should not be destroyed until after the destructive effect of these machines, under power, has been completed.

17. To drop an overhead crane, it is usually best to first suspend from the crane, the heaviest object available, then prepare to cut the supporting track on one end with TNT or acetylene torch. These tracks are usually of "I" or "T" beam construction, with heavy webs, and therefore, require sufficient one-half pound blocks of TNT to make almost a solid necklace around the entire member, at two points. The value of the destruction accomplished is sufficient to warrant this rather large expenditure of explosives or thermite, though the job can be equally well done by using acetylene torches, of which many will be found in railroad shops.

18. If the turntable recess destruction method outlined above is not available, or is exhausted, and other locomotives remain to be destroyed, two methods may be considered. On those that have some steam and fire it is advisable to open the steam valves, screw down the blow-off safety valve, usually located on the top of the boiler, build up the fire, then turn off the steam output. If a normal operating pressure of steam is in the locomotive at the time this operation is begun, the boiler will explode within a few minutes, and upon explosion will demolish the entire locomotive. It will also destroy or disable other lighter types of machinery within an area of several hundred feet.

19. Another effective method is to turn off the water supply to the boiler. which is located on the left side of the cab, and usually very clearly indicated; (See Fig. 9) drain the tubes, which is accomplished by opening the valve near the lower front of the left side of the engine cab, then build up the fire. This will destroy the boiler but not the remainder of the locomotive, as an explosion will not take place. The heat will merely melt the tubes within the boiler.

20. Cold boilers, which normally will be found in the shop where boilers are undergoing repair, may be destroyed by detonating several blocks or sticks of explosives in the tubes, but this method is not recommended due to the extremely large amount of explosives required to do a small amount of damage. Tubes are quickly replaced where normal repair facilities exist. However, if the latter are destroyed it would require considerable time to replace even a few melted tubes. The use of an acetylene torch is

recommended, as many tubes could be severed within a few minutes with one torch.

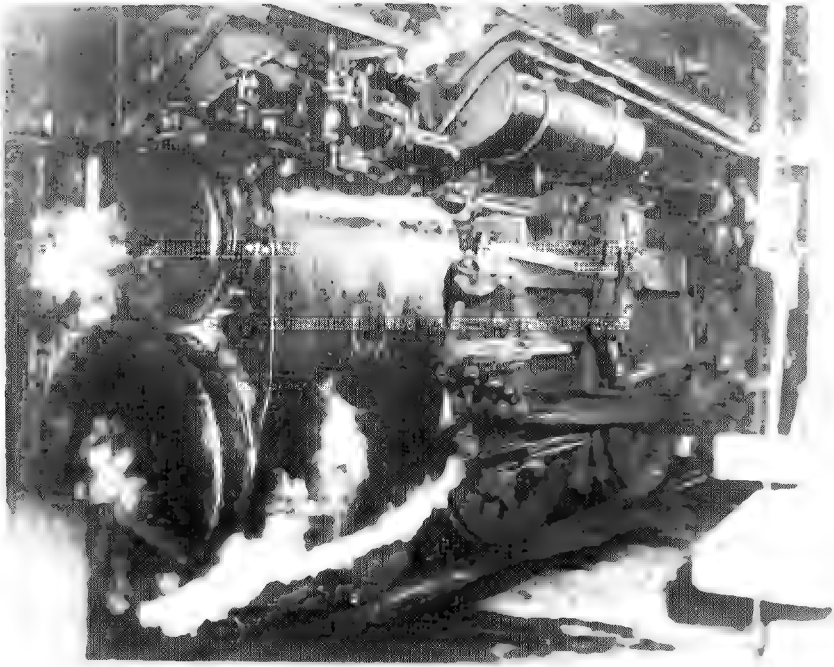


Fig. 8. Locomotive steam chest. cylinder-piston assembly

21. Locomotives may be put out of commission for a considerable length of time through the use of explosives in the cylinder heads, piston rods, or driving shafts, as shown in Fig. 8. These are very difficult to replace, especially if similar units are destroyed on all locomotives, and in the parts room.

22. Another very effective method of wrecking a locomotive is to wreck the atomizer with a one-half pound block of explosive, which will allow a solid stream of oil to flow into the firebox, which will accumulate much faster than it can burn. This oil will flow out and over the rear of the locomotive, and if allowed to burn for any length of time will result in almost complete destruction of that particular engine. The tender should also be breached in order to supply additional fuel to the fire. If the heat of the firebox makes it impossible to attach explosives to the atomizer, it may be destroyed by small arms fire. Oil saturated waste should be ignited and tossed into the firebox if the primer isn't functioning.

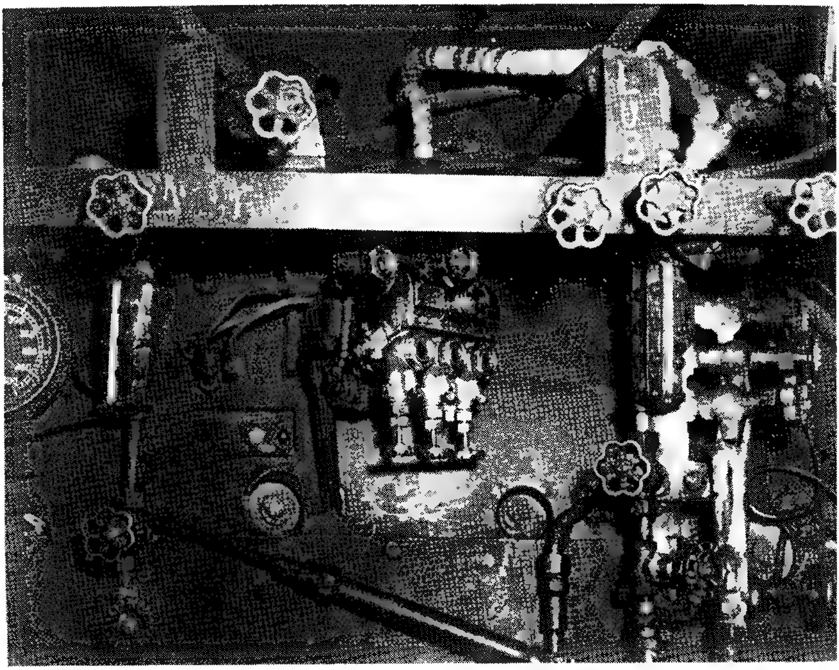


Fig. 9. Lubricating and water control valves in cab

23. Fig. 9 shows the three typical valves, which control the lubricating oil for a locomotive. If these three valves should be shut off and the locomotive started down a mainline track, it would destroy itself within five or six miles, if running under no load, and within a shorter distance if some load is attached, or the brakes are slightly set so that it is operating under a load. Fig. 9 also shows in the upper left portion the water supply valves, which should be shut when attempting to melt the boiler tubes, as discussed in paragraph 19 above.

24. In the blacksmith shop and foundry the only important items to be demolished would be the forges and automatic hammers, as illustrated in Fig. 10. Demolition of the forges would require considerable explosives, which may not be justified, unless complete destruction of all facilities is desired. Usually the foundry building and contents will be destroyed upon the breaching and firing of the nearby fuel oil supply tank. The automatic hammers should be used first to break up small parts of important machines, such as are usually carried in the machine shop. When the hammer has completed its mission, it should be destroyed by fusing the piston to the frame with thermite, or by destruction of the frame at the neck with explosives.

Fig. 10. Automatic hammer

25. After all power devices have been used to assist in the destruction, attention should be turned to the source of power for the yards. This will be a typical steam or Diesel electric power installation, such as has been covered under that chapter of this manual having to do with power. The methods of destruction are covered therein and it is therefore considered unnecessary to repeat here. One piece of equipment, however, which will normally be found in a railroad power house which may not be found in other power installations, is one or more compressors. Fig. 11 shows a typical compressor installation; and particular effort should be made to destroy these units. This can easily be done by tying down the release valve on the air compressor tank, shown in the center background of Fig. 11, then speeding up the motor, and just before leaving, shut off the air output valve. The pressure developed within a few minutes will not only destroy the compressor unit but most of the other machinery within the building.

26. Just before leaving the shop area, care should be taken to set everything inflammable on fire, in order not only to destroy additional facilities, but to hamper repair work. There is ordinarily a large oil tank on the premises which furnishes either lubricating or fuel oil to the shop area, and rupture of this tank, and the setting of the resultant oil flow on fire, will do considerable damage.

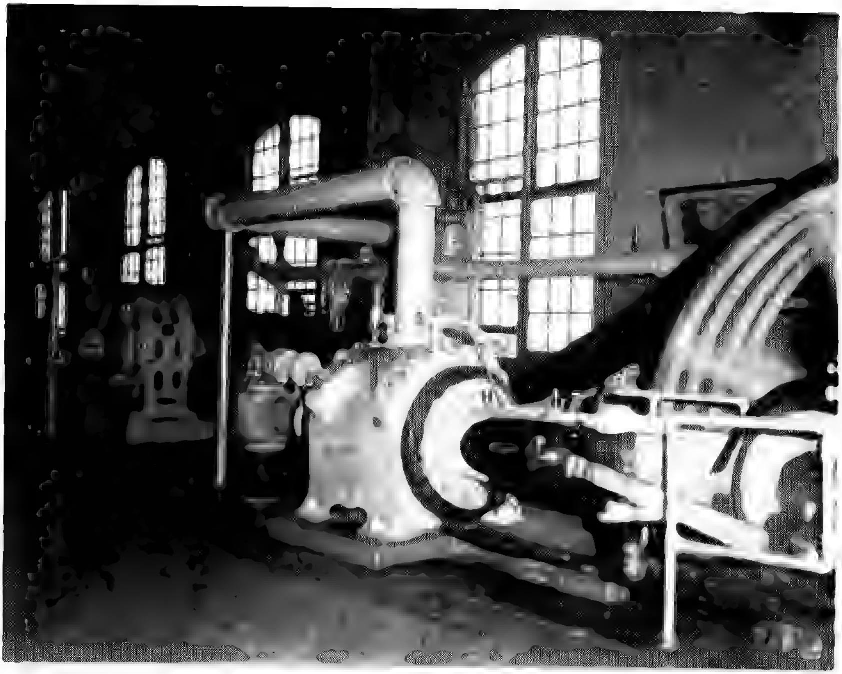


Fig. 11. Large capacity reciprocating compressor

Fig. 12. Piping on top of roundhouse

27. Fig. 12 shows the normal pipe system on top of the roundhouse. These various pipes supply fuel and lubricating oil, acetylene, gas, steam, and water. The acetylene and the oil line should be breached and the resultant flow set afire, as under normal circumstances the damage caused thereby would be very effective over the entire roundhouse area.

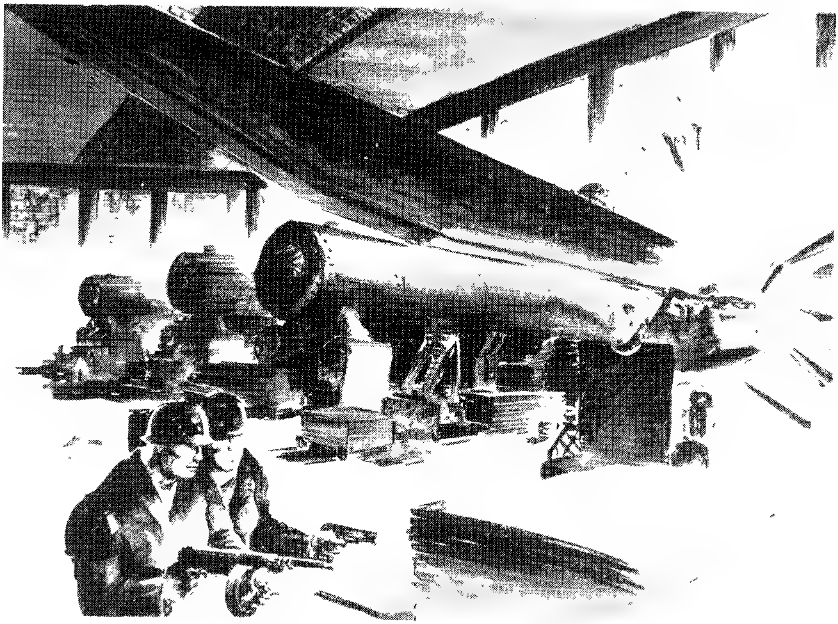


Fig. (c) The overhead crane should be blown from its tracks onto equipment below

RAILROADS—AVIATION

28. In the foregoing paragraphs of this chapter an attempt has been made to show the surface demolition group the relative importance of various machinery and services within a railroad shop area, and where these will normally be found. From the aerial point of view these same conditions govern, except that the precision with which certain acts of demolition are performed, are impossible from the air. However, the same targets exist for aerial bombardment, and here will be shown the order of importance in which those targets should be destroyed.

29. Fig. 13 illustrates typical large railroad shops and yards, and the principal target areas are appropriately indicated therein.

30. The turntable in the roundhouse becomes the principal target of an air attack. The destruction and delay occasioned by a hit on this object can readily be appreciated by counting the number of visible locomotives, which could not be put into operation for at least thirty days.

31. The target of second importance is the large capacity, traveling cranes necessary to the repair of boilers. The boiler repair yard seen on the immediate right of the two cranes is not considered an important objective for aerial attack.

32. The building indicated by T-3, is the target of third relative importance, and houses one, or possibly two, additional large capacity cranes, and probably numerous engines in various states of repair.

33. T-4 shows a powerhouse, and in view of the fact that most of the separate pieces of machinery are easily replaceable, this is considered less important than the targets mentioned above.

34. The oil tank indicated by T-5 probably represents one of the lesser important targets in the area, but in this case its proximity to a large factory and the roundhouse, and its slightly higher elevation, makes it an important target for demolition and incendiary bombs. The point of aim is indicated by a white dot, as a hit here would breach the tank and the retaining wall and permit the ignited oil to flow into the area of the roundhouse, and the factory.

Fig. 13. Vertical view of large maintenance and repair shops

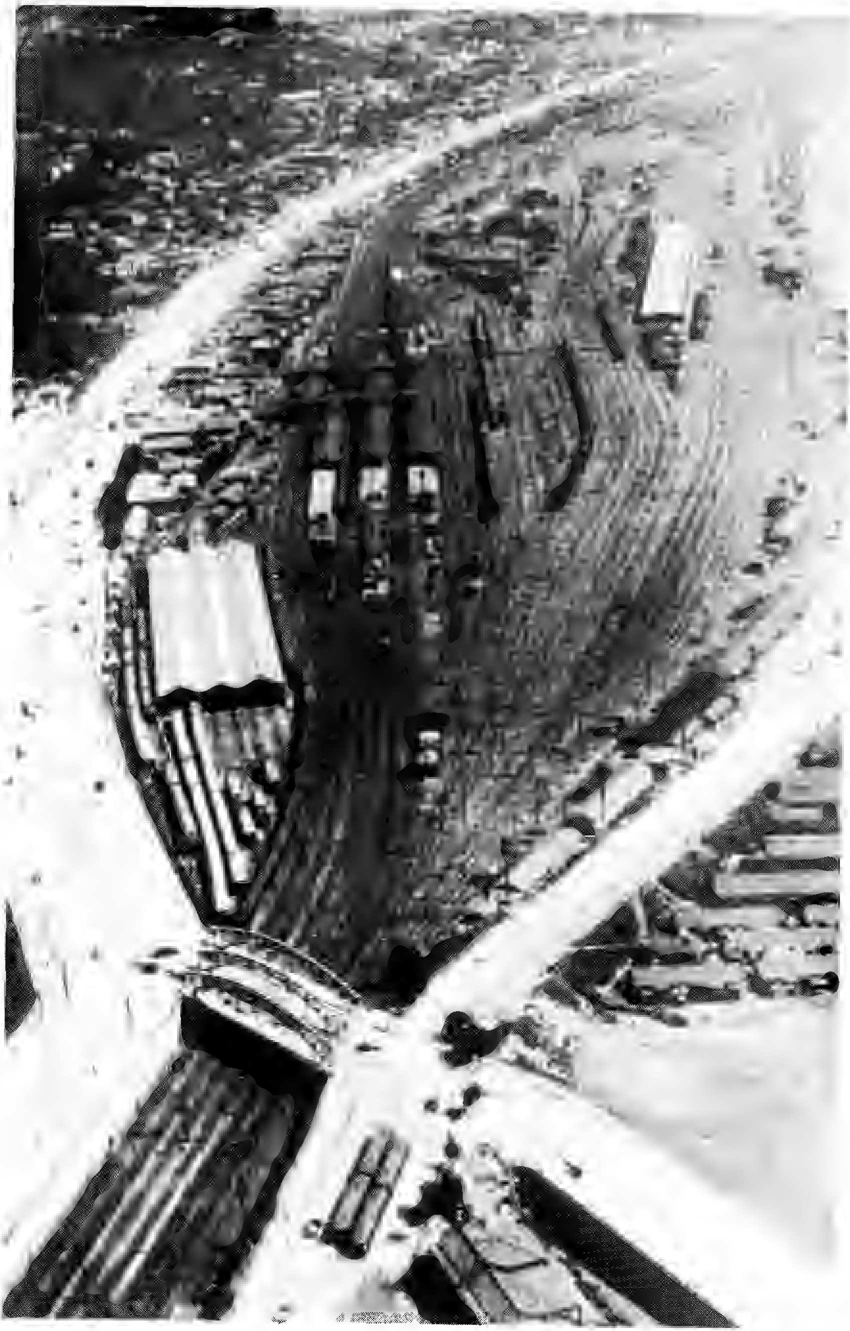


Fig. 14. One of the two principal yards in Tokio, Japan

Fig. 15. Vertical view of yard area

Fig. 16. Vertical view of yard area

35. T-6 is not considered an important target as it houses the equipment and repair factilities for box and other types of freight cars, which are not particularly important, unless total destruction is planned.

36. T-7 indicates the blacksmith shop and foundry which is not considered a target of the first importance, because the machinery therein is of such a massive nature as to require practically a direct hit in order to seriously damage the same.

37. The switch yards shown across the immediate foreground are extremely vulnerable to bombing attack, providing that the correct targets are selected. Ordinarily the area in which cars are congested isn't a good target, as they are usually assembled in an area somewhat apart from critical rail switches. The point of aim should be along the base of the angles formed by many switches. Hits in these areas will destroy so many switches that not only will most of the rolling stock in the area be immobilized, but the repair work on the switches would be tremendous, and may require months to complete.

38. Fig 14 shows one of the two principal freight yards in Tokio, Japan, and clearly indicates that the shop, roundhouse and track layout is generally the same as may be seen in other illustrations herein.

39. Figs. 15 and 16 show typical shop and yard areas from a higher altitude, and it is suggested that the student study these carefully, in order to determine the areas of relative target importance, based upon the material shown elsewhere in this chapter.

40. Included in Fig. 15 is a very large refinery and oil storage area, containing every operation important to this industry. The R.F. is 1″=1667′ and it is suggested that the student also identify relative target importance. on the basis of that chapter herein dealing with oil refineries.

MISCELLANEOUS

BRIDGES:

1. The destruction of bridges is a subject which is sufficiently important and involved to require a special course of study. Various types of bridges require different methods of destruction and the importance of calculating and placing charges on each type should be covered more thoroughly than is contemplated herein. Here it is intended only to show the principal point both by surface and air attack on a few types of bridges.

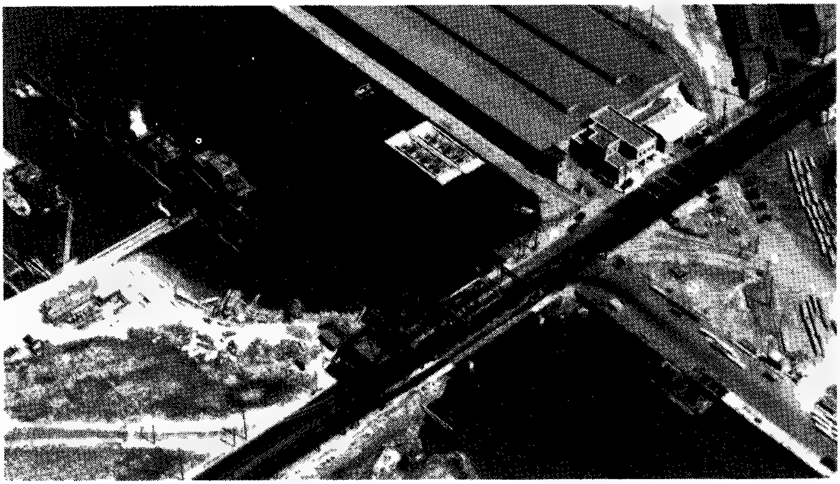


Fig. 1. Single span jackknife drawbridge

2. Fig. 1 illustrates a single lift draw-bridge spanning a small ship channel. The lift of this bridge is actuated by machinery, and a huge counter balance opposite the span. The best method of destroying this bridge would be to elevate the same to its highest point and while held there sever the principal steel members supporting the counter balance. The steel members to be severed should be those at the extreme outward point of the counter balance, so that upon severing it would either fall or swing downward and inward. The immediate effect would be to cause the draw to fall with its full weight and with sufficient force to crash through the opposite abutment and down into the channel. The weight of the bridge would be sufficient to destroy the worm-gear mechanism, so that this would not have to be destroyed in order to allow the bridge to fall.

3. Fig. 2 illustrates a draw bridge in which the entire center span is lifted vertically, on the two elevating towers visible through their shadow in the figure. The point of attack on this type of bridge would be either or both of the tall towers, as here the counter weights and lifting machinery are located. The same method of destruction as outlined in the paragraph preceding also applies for this type of bridge, in that the center span should be elevated to its highest point and then the counter weights in each tower severed. This is usually much more easily accomplished on this type of bridge, as the counter weights are normally free running and suspended by wire cables.

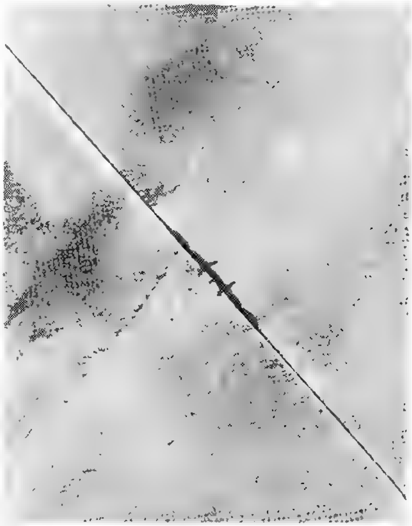


Fig. 2. Vertical lift drawbridge

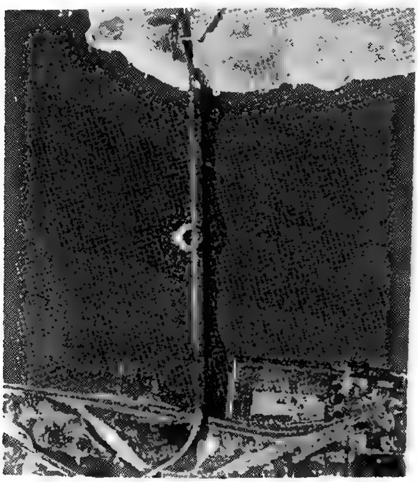


Fig. 3. Through-truss double span bridge

4. Fig. 3 illustrates a through-truss type bridge consisting of two principal spans from the center pier. The shadow gives an excellent plan view of the span construction. Here it is obvious that the center pier is the key to the bridge construction and is the point at which any attack should be directed.

5. It may be generally said of bridges that the point at which the principal effort should be directed, in their destruction, should be at that point where it would be most difficult for the enemy to reach or work in the repair effort. This of course presumes that the structural design of the bridge must be first taken into consideration.

6. In Fig. 4 will be seen a split-section draw-bridge of the jacknife type, in which two counter weights raise the span in two sections from the middle. This is the same type bridge as shown in Fig. 1, except that there are two identical sections, and this type becomes necessary where a larger

Fig. (a) Several types of bridges across Sumida River, Tokio, Japan

Fig. 4. Two section jackknife drawbridge

opening is desired to accommodate the passage of larger ships.

7. A large modern factory is also shown in Fig. 4 and it is recommended that study be made thereof, in order to determine the vulnerable spot for attack of a plant, constructed as this one is, under one roof. Obviously the powerhouse at the upper right hand corner of the plant should be the principal object. Attention is directed, however, to the four principal areas of exhaust shown by discoloration of the roof. Obviously hereunder are situated engines or machines, which are probably more important to the opera-

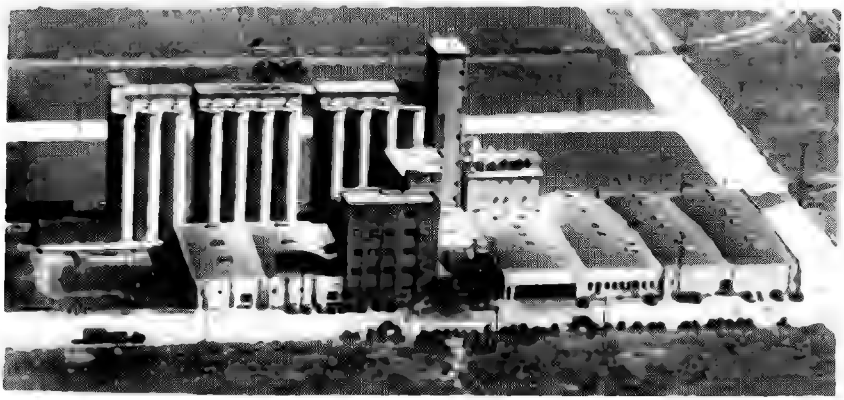


Fig. 5. Cereal mill

tion of the plant than anything contained in the other areas. The absence of camouflage gives a much better opportunity to discern areas of this nature, but they are pointed out here merely to illustrate the point that wherever possible, power should be sought as the target of first importance.

Fig. (b) Single through-truss span in Tokio, Japan

8. Fig. 5 illustrates a typical flour mill and it is shown only for the purpose of indicating that in this type of industry, as well as most others, the powerhouse is the important target to reach. Here it is obviously the transformer station shown in the center foreground, and the milling and elevator house shown in the center of the picture. Destruction or damage to this unit

Fig. (c) Tokio bridges

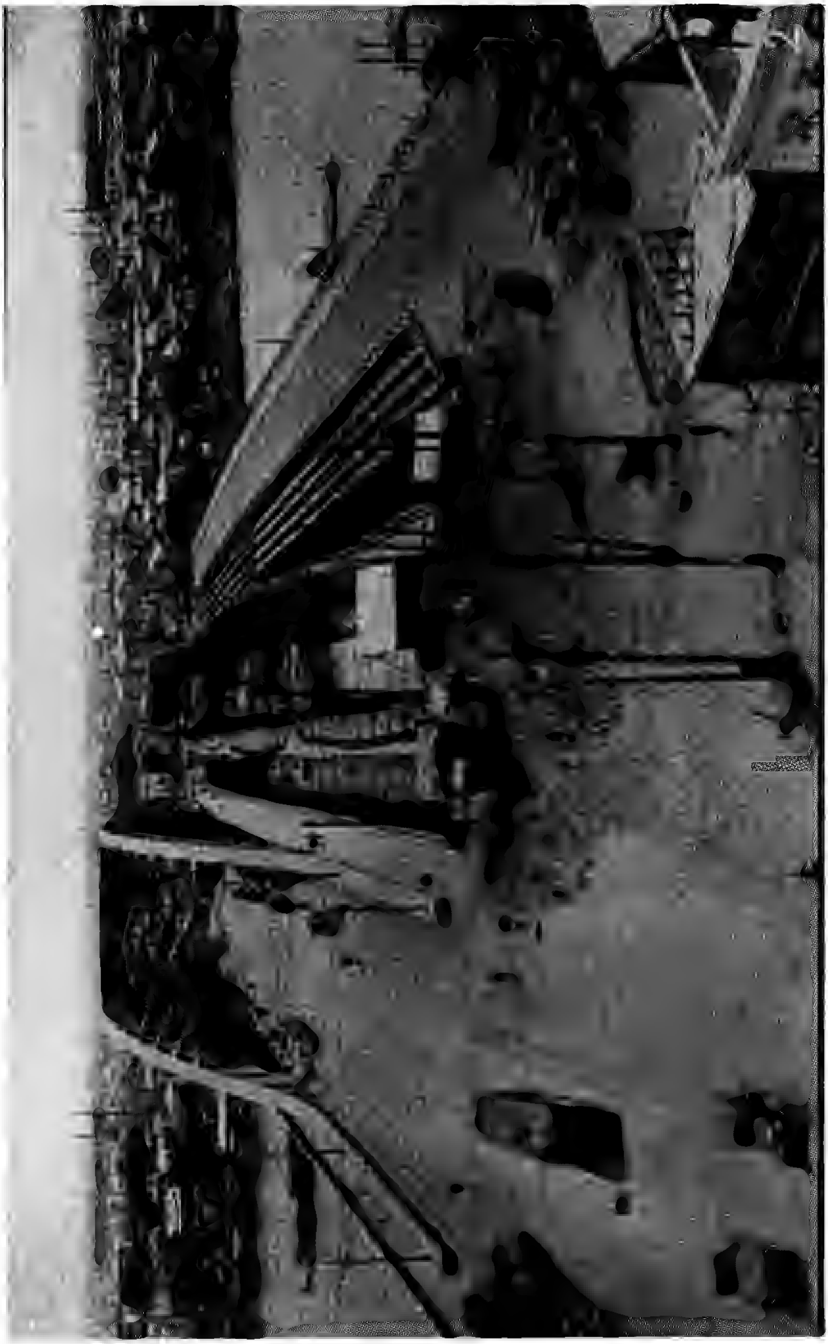


Fig (d) Several types of bridges across Sumida River, Tokio, Japan

Fig. (e) Section of world's largest open-cut coal mine, near Mukden, Manchuria (the vulnerable areas are the 4 loading hoists in the center of the figure)

Fig. 6. Waterfront section of industrial city

would stop all other plant activity, and make it impossible to reach the stored products in the storage elevators until power was restored.

9. Fig. 6 is reproduced for the purpose of illustrating a complete waterfront of a modern city. Except for minor variations in the residential areas it could be almost any place in the world. Within this figure are shown the essential parts of a major railroad terminus, including those elements which have been shown elsewhere in this manual to be the heart of a railroad transportation system. Also included are ship building yards, with floating and sunken dry docks, and ferry slips for passenger and railroad accommodation. A natural gas compression and storage plant is shown, as well as dock and warehouse facilities. A steam power plant is pictured, as well as a fireboat station. Within this area are many of the industries and activities which have been discussed in this manual, and it is recommended that the figure be studied closely, in order that all personnel training or engaging in this type of destructive effort, should train themselves to recognize quickly the heart of the activity, which has been designated or becomes their target.

Fig. (f). Fires should be started in storage rooms containing critical equipment and should be assisted with inflammable materials

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